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THE NATICOID GENUS STROPHOSTYLUS.[1]

BY CHARLES R. KEYES.

AMONG the well-marked generic groups defined by Conrad is one to which the name Platyostoma was applied. This term was proposed in 1842;[2] and since that time it has come into common use in American Paleontology. The group embraces a considerable number of familiar species, ranging in geologic time from the Niagara epoch to the close of the Paleozoic. It is rather unfortunate, therefore, that the term had been preoccupied, having been used in generic diagnoses on at least four different occasions. Megerle early applied this name to certain mollusks closely related to Buccinum; but so far as is known no formal publication of the term was ever made. Were this the only obstacle in the way, Conrad's genus might be allowed to stand, for the reason that Megerle's proposition was only in manuscript. Klein,[3] however, proposed *Platystoma* in 1753 for a genus of Cyclostomacea. Meigen[4] adopted the same term in 1803 for certain flies, and Agassiz,[5] in 1829, also used it for a section of Silurid fishes. The preoccupation of Conrad's Platyostoma by Klein's Platystoma, like a number of similar cases, has been objected to on the ground that the two terms, while derived from the same words, are not identical, because Conrad's compound has a connecting *o*. It is

[1] Read before the Iowa Academy of Sciences, September 5, 1890.

[2] *Jour. Acad. Nat. Sci.*, Phila., Vol. VIII., p. 275.

[3] Teut. Meth. Ostr., 1753.

[4] *Illig. Mag.*, Vol. II., 1803.

[5] *Pois. Foss.*, Vol. II., 1829.

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quite manifest, however, that both generic words are taken from *platys* and *stoma;* and that from these it was the intention of Conrad to construct a correct generic term. In this attempt he used by mistake the connecting *o*, which is necessary in forming compounds from most Greek words, but which in the present instance was not called for, since the term is formed directly without the intervention of a copulatory vowel. For these reasons Conrad's and Klein's proposals cannot be regarded as distinct.

Since it is clear, then, that Platystoma cannot be retained for the American group of Paleozoic gastropods, some other term must be adopted. Fisher[6] has taken advantage of the questionable validity of Conrad's name, and has recently proposed Diaphorostoma for the same group, with *Platystoma niagarensis* Hall for his type. This writer places Hall's Strophostylus as a subgenus under Diaphorostoma; while Zittel[7] assigns Hall's section to a similar taxonomic rank, but under Platystoma. Had Conrad's type of Platyostoma not been a form midway between the two extremes of a series forming the group Fisher's name might be retained, but the type of Strophostylus is congeneric with *P. ventricosum;* and as this name is the next proposed it must be taken into consideration. Were it not for this fact two sections of this group of shells could be with great propriety made. As regards the term Strophostylus, it was established by Hall[8] in 1859 for certain shells closely related to Platystoma, but differing chiefly in having a slightly "twisted or spirally grooved columella."

Recently a large series of the most important species of both Platystoma and Strophostylus was examined and the matrix carefully removed from the apertural portions of many of the shells. The structural features disclosed in the various forms show a relationship between the two established genera that was long suspected. It is well known that the type of Conrad's genus —*Platystoma ventricosum* Con.—is a somewhat globose shell with a small spire elevated slightly and having the aperture broadly ovate. The inner lip is somewhat thickened and subangular

[6] Man. de Conch., p. 756.

[7] Handb. der Palæ., I. Band, 2 Ab., p. 217.

[8] Palæ. N. Y., Vol. III., p. 303.

within, giving a slight indication of a columella. In all respects it very closely resembles the typical forms of *Strophostylus cyclostomus* Hall from the Niagara shales of Waldron, Indiana. The shells described under Platystoma subsequent to the appearance of the original diagnosis vary more or less from the typical species. The general tendency, however, has been to include under Conrad's genus those forms having a rather small, depressed spire, the inner lip rather thin, and simply reflected over the body-whorl. Often the lip does not touch the second volution and the mouth of the shell is frequently free for a considerable distance. Some of these forms closely approach Paleozoic species of Capulus.

When, in 1859, Hall examined the interior of a Platystoma-like shell (which he afterwards called *Strophostylus andrewsi*), he found that the specimen had the inner lip considerably thickened and somewhat angular within. As a matter of course the interior angularity appeared twisted on account of the continued enlargement of the shell to the adult stage. In some individuals the thickening was considerably exaggerated, and formed a short projecting lamella or ridge. But from the figures given by Hall it is clear that this was not entirely characteristic, and the two specimens figured in the text differ widely in this particular. Nevertheless Strophostylus was proposed and has since been applied to nearly a score of species.

The limits of Conrad's and Hall's genera have never been precisely defined in the descriptions of species, and the larger majority of the forms in question have manifestly been assigned to their respective groups more on account of the general shape of the shells than from an examination of the columellar parts, which were only in exceptional cases visible without the removal of the hard matrix.

From the foregoing it is evident that Strophostylus and Platystoma are practically identical, and that therefore the two must be regarded as synonymous. The type of the first section, *Strophostylus andrewsi*, actually stands at one extremity of a rather extensive and variant series of shells of which *Platystoma ventricosum* is one of the median members. At the other ex-

tremity are the capulus-like forms, similar to those described by White and Whitfield as *Platyceras bivolve.*

The synonymy of the genus is as follows:

1842. Platyostoma, Conrad, Jour. Acad. Nat. Sci., Phila., Vol. VIII., p. 275. (Not Klein, 1753; nor Meigen, 1803; nor Agassiz, 1829.)

1859. Strophostylus Hall, Palæ. N. Y., Vol. III., p. 303.

1885. Platystoma Zittel, Hand. der Palæ., Band I., 2 Ab., p. 217.

1887. Diaphorostoma Fisher, Man. de Conchl., p. 756.

The following species are regarded as members of the Strophostylus group. Of the species originally described under this genus as understood by Hall, and under Platystoma, several have not as yet been sufficiently examined to determine definitely their generic position. The majority of those omitted, however, are mere internal casts or fragmentary individuals, which have no value whatever morphologically; and from a geologic standpoint possess only doubtfully generic interest.

Strophostylus andrewsi Hall.
Platystoma arenosum Conrad.
Platyceras bivolve White and Whitfield.
Platyceras billingsi Hall.
Strophostylus cancellatus Meek and Worthen.
Strophostylus cyclostomus Hall.
Strophostylus elegans Hall.
Strophostylus fitchi Hall.
Platystoma lineatum Conrad.
Strophostylus matheri Hall.
Platystoma niagarense Hall.
Strophostylus obtusus Hall.
Platystoma peoriense McChesney.
Platystoma pleurotoma Hall.
Platystoma strophium Hall.
Strophostylus transversus Hall.
Platystoma turbinatum Hall.
Strophostylus unicus Hall.
Pleurotomaria unisulcata Conrad.
Strophostylus varians Hall.
Platystoma ventricosum Conrad.

Strophostylus, as now understood, embraces three rather well-marked types of shells. One of these sections contains chiefly those extreme forms upon which the genus was originally founded. These shells are subglobose, with the spire somewhat elevated; the columellar parts are prominent, and the front portion of the inner lip is considerably thickened, often having a distinct depression or groove which continues inward around the columella. This group finds its greatest development in the Upper Silurian. Another section includes shells similar to *Strophostylus* (Platystoma) *niagarensis*, in which the spire is depressed, the inner lip simply anchylosed to the body-whorl, and thickened to little or no extent. These forms predominate in the Devonian. They closely approach certain Capuli which have been called Platycerata, and it is very probable that the generic position of a number of species in the latter genus will be modified upon more critical examinations of all the forms. To the third section belong chiefly Carboniferous shells like *Strophostylus* (Platystoma) *peoriensis* McC.

The most striking points of difference in the various forms here referred to Strophostylus are found in the columellar region and along the inner margin of the aperture. The columella is in no species perforated for the umbilicus. In those species showing these parts in the greatest perfection there is a considerable thickening of the forward portion of the inner lip. This thickening is frequently more or less distinctly grooved within, parallel to the apertural margin, and consequently a prominent ridge often borders the groove towards the interior. As the shell increased in size the inner lip became reflexed, making the parts still more massive. The spiral ridge around the axis of the shell thus acquires considerable prominence in some places. In the extreme forms, as *Strophostylus andrewsi*,—the species upon which Hall based his genus,—the columellar ridge forms a kind of elevated lamella, but this exaggeration is by no means constant in the different shells of the species, and in some specimens it is scarcely more conspicuous than in certain individuals of typical *Strophostylus matheri*, or even examples of *S. cyclostomus*. Through the latter two closely allied forms the transitions are made in easy

stages to *S.* (Platystoma) *ventricosus.* In some of the varietal examples of the last-mentioned species a peculiar change in the inner lip begins to make its appearance. But this feature is perhaps better shown in a large series of *S. niagarensis*, its near congener. The lip, instead of being firmly united and fused with the body-whorl, as is the case with most of the forms originally described under the genus, commences to separate from the adjoining volution. In these shells the columellar parts become greatly reduced, and even almost wholly reduced, while the thickening of the inner lip entirely disappears. Nor does the change in this feature end here. Many of the individuals show a tendency to uncoil, some of them having the last whorl separated from the preceding volution by more than half a turn (Pl. XXXIII., Fig. 3). The resemblance of certain varieties to some forms of Capulus (Platyceras of Conrad) is very striking, as has been remarked elsewhere.

The genetic relationships, as at present understood, of the leading species of Strophostylus are graphically represented in the accompanying scheme (Pl. XXXIII.). The earliest-known forms of this group are from the Niagara rocks; but the extended vertical range of such species as *S. ventricosus* would indicate that the specific type has a higher antiquity than present information would suggest. Three principal series developed from this primitive type: (A) one preserving more or less distinctly the original characters; (B) another degenerated more or less, giving rise to loosely coiled shells and those approaching the Capulus group; and (D) a third exhibits intensified features which are particularly noticeable in the region of the columella. Fig. 1 represents the species upon which Conrad based his genus Platystoma, and was called *P. ventricosum.* It chances to be the most generalized as well as one of the oldest forms of the group. The series D showed a continued progression in the development of the axial parts, and finally ended in a form having a conspicuously twisted columella, as was acquired by *S. andrewsi* (Fig. 23). This exaggerated character in the species last alluded to was the basis of Hall's genus Strophostylus. But it will be seen at once that the species selected was actually an extreme development of a variant

series, and is connected by a complete gradation of forms with the earlier and less specialized one. Later in the history of the most primitive form now known an exceedingly variable series (C) is given off, which assumes in the several species diverse characters. Some vary more towards the *S. andrewsi* type, while others tend towards the *S. niagarensis* section. In the variable forms of *S. turbinatus* some significant phases are presented which suggest the relationship of these shells to certain other genera. In the extreme form appears an elevation of the spire that is unknown elsewhere in the group. Some examples show scarcely any thickening of the inner lip or columella, while others have these features well developed.

It must be borne in mind that the scheme as here represented is intended to indicate merely the lines along which the several developments took place, rather than the phylogenetic history of the group. The correct determinations of the phylogeny of animals from paleontological evidence is attended with many difficulties. For, as repeatedly shown by Darwin and others, new variations tend to be transferred backward in the ontogenetic history of a species, and may disposess older characters. This, taken in connection with the fact that variant changes may occur in one part of an organism without materially affecting other parts, calls for extreme conservatism in passing judgment on phylogenetic problems from evidence afforded by fossils.

Explanation of Plate XXXIII.

Fig. 1. *Strophostylus ventricosus* Conrad, Lower Helderberg. 2. *S. niagarensis* Hall, Niagara. 3. *S. niagarensis* var., Niagara. 4. *S. niagarensis* var., Niagara. 5. *S. bivolvis* White and Whitfield, Lower Carboniferous. 6. *S. ventricosus* Conrad, Oriskany. 7. *S. peoriensis* McChesney, Upper Carboniferous. 9. *S. lineatus* Conrad, Upper Helderberg. 10. *S. lineatus* var. *calosa*. 11. *S. varians* Hall, Upper Helderberg. 12. *S. varians* var., Upper Helderberg. 13. *S. lineatus* Conrad, Hamilton. 14. *S. unisulcatus* Conrad, Upper Helderberg. 15. *S. turbinatus* Hall, Upper Helderberg. 16. *S. turbinatus* var. *cochlea*, Hamilton. 17. *S. turbinatus*, var. 18. *S. expansus*, Oriskany. 19. *S. cyclostomus* Hall, Niagara. 20. *S. transversus* Hall, Oriskany. 21. *S. arenosus* Conrad, Lower Helderberg. 22. *S. matheri* Hall, Oriskany. 23. *S. andrewsi* Hall, Oriskany.

CONTRIBUTION TO THE KNOWLEDGE OF THE TERMITES.

BY FRITZ MÜLLER.[1]

IN the opinion of profound students (Hagen in Linnæa Entomologica, 14, page 126) respecting the surprising multitude of different conditions which exist in Termite colonies, only the nymphæ with short wing-cases formed until now an insoluble mystery. As an introduction to the effort to bring this mystery nearer to a solution, I will mention some facts about the family life of the Termites. At a certain season (for different species differ) the winged males and females leave the nest in which, several weeks before, their last moulting has taken place, and raise themselves up in thick swarms in the air. After a short flight they sink to the ground, and rid themselves of their wings. During this begins the search of the male for a mate, and the successful pair try to get a nest for their eggs. Before they accomplish this intention, the majority of the defenceless animals are overwhelmed by the persecutions of the common ants, the birds, and other enemies. Only after a pair as king and queen have found admission in a nest follows a true matrimonial state, during a year, as the result of a betrothal celebrated outside of the nest. The fructification takes place neither in the air nor at all outside of the nest. This representation agrees in nearly essential points with that which Smeathman has given nearly one hundred years ago (1781), but the later zoological books seem to differ from it. Some writers seem to think that the Termites couple (copulate) in the air, or at least, outside of the nest, and that the males perish afterward, and the fructified females are brought back into the nest.

That the male with his female return again to the nest, and live as king and queen, needs no further proof, for besides Smeathman, Lavage, Lespes, Bates, and others have found such kings with different species. Also, later, Dr. Hagen declares

[1] Translated from the German by Mrs. Lucy Bronsen Dudley.

that the existence of such a king appears certain beyond doubt, from the manifold statements of reliable observers, and from numerous specimens of such nest-dwellers (Hagen 12, page 16, and at other places). And I also have found the king with eight or nine species of the genus *Calotermes* (*rugosus*, *nodulosus*, *hagenii*), *Termes lespesii*, *Eutermes inquilinus*, *Anoplotermes pacificus*, and others.

At the time of the swarming the reproductive organs are very small; after the return to the nest they grow so large that they fill the greater part of that sometimes much-swollen hinder part of the body. So there is no doubt about the probable, often-repeated fructification in the interior of the nest; by this, of course, a former fructification outside of the nest is not excluded, though it is very uncertain at the time of the swarming, for the reproductive organs (testicle and ovary) are then so little developed. Burmeister could not discover the interior reproductive parts of the winged animals, even of one of the larger species (*Termes dirus*); and also Dr. Hagen examined many (alcohol) specimens of winged Termites without finding reproductive organs. (Communication by letter of Nov. 25th, 1871.)

Some even take the majority of a Termite swarm as sterile individuals. By this it can be understood how small the reproductive parts of the winged animals are in comparison to their later enormous circumference; for example, I will state that with the winged males of our largest Eutermes species the reproductive organ (testicle) is scarcely 0.3 mm. in diameter. If the Termites possessed the seed-thread of the other insects, so striking to the eye as scarcely to be mistaken, then would the question be easy enough to decide whether the winged males would be able to fertilize the females outside of the nest. In mature kings (sexual males) of different species I found in the reproductive organ (testicle), only partly larger, very pale, roundish little bodies of about 0.008 mm. in diameter (with *Eutermes vernalis*, masculine) which seem to be without a cover. If water is added it increases in size as large again as before. Partly smaller ones, pretty strong and light-refracting little balls, have been found, scarcely 0.002 mm. in diameter. The former are probably the

fructificating ingredient of the semen. They are so pale, and their form is differentiated so little, that I cannot say with precision whether they are found with the winged males. I have until now looked in vain in the reproductive organ (semen pocket) of the queens, as well as in that of the winged females. If I have rightly seen, those with the winged males (the large-ball, nest-building Eutermes) already exist, but still enclosed in cells.

Until now, a couple of Termites have not been caught in the act of fructification (copulation). What may have been taken for it are the pleasure walks of the couples, many times observed, which they take together, the female in front and the male close behind, often seizing the hinder body of the female with his mandible. These peculiar walks have I seen repeatedly with the species *Termes lespesii.* Of this kind I brought matured individuals (imago) out of the nest into a glass. They seemed to have the habit, after a short restlessness, to become heaped over each other in thick layers, as they had been accustomed to sit quietly at the bottom in the chambers of the nest. I poured them on a sheet of paper, and they pushed themselves gradually, one couple after the other, out of the crowded heap, so as to get slowly away from the heap.

Some couples, however, separated themselves soon again; these were two males, as far as they could be examined. The others, which kept together, consisted always of a female in front and a close-following male; the latter was up to the hinder half of the wing, or in case the wings had been already thrown off, completely hidden under the wings of the female. If it was sometimes a step backward, the female seemed to wait for it. Not seldom had the male really seized for a time, with his mandibles, the point out of the hinder body of his mate (as Rosenschold gives, and not apparently, as Lespes saw with *Termes lucifugus*). It seemed to be a sort of bridal caressing. Of fertilizing I have seen as little as Smeathman, Rosenschold, Lespes, Tollin, and others. The object of these pleasure walks is probably to find a nest for a new home for their species.[2]

[2] Mènètriès relates, in a curious report of mixed truth and error (Linn. Entomologica, page 116), that these pleasure walks ended with fertilization.

I believe this statement is doubtful, just as much as that of the Termites of Serra da

I would pass over in silence the pretended congress (copulation) in the air if Azara and Rengger had not claimed to have seen the same in Paraguay, and they rightfully have the reputation of good, reliable observers. In this instance of the Termites, however, they have not justified this reputation, for Azara gives the Termites six wings, and Rengger found the ground covered for fifteen minutes with male Termites, or at least their wings. Unfortunately he says just as little as to how he could make out the wings to belong to males, as in what way the copulation in the air took place.

Rosenschold relates, also, that out of the thick swarms of an indigenous kind the animals fall down in couples, so that the above-mentioned pleasure walks may begin. With the poor ability to fly, and the deficiency of reproductive organs of the Termites, the copulation in the air I think to be distinctly impossible. So much in justification of the statements of Smeathman, as against the different opinions of scientific zoologists. His representations of the reproductive (sexual) life of the Termites seems—as far as I can judge from the facts collected in Hagen's monograph—to be exactly right from my own experience. However, this point is yet incomplete for many other species, if not for those observed by Smeathman (*Termes bellicosus*). It finds therein no consideration for nymphæ with short wing-cases, or better wing beginnings.[3] These animals have been ob-

Mantiquera denuding the trees of the foliage to carry the leaves to their nest is probably a mistake (with ants of the species Œcodoma); that the males of these Termites have stronger mandibles than the females, and that the latter already in the first two or three days after their return home lay their eggs. With other species at this time quite unripe eggs are thrown out of the nest, and some places in Brazil roasted mandioc roots furnish the chief nourishment of the inhabitants, etc. Mènètriès never found, during a five years' sojourn, a Termite in really virgin forests in different provinces of Brazil, which probably all together have more Termites than our St. Catherines. In my own native forest live more than a dozen species.

[3] The name wing-cases is applicable only for the oldest nymphæ which have passed beyond their wing beginnings. Real wing-cases will be developed at the next moulting, and are not present in cases where the wings are not developed.

Dr. Hagen is correct (Linn. Ent. 14, page 126) in blotting out the so-called short wing-cases of the soldier nymphæ from the line of forms of the Termites as very unwarranted. But there are soldiers with wing attachments, out of which wings ought to become veloped; if not soldiers at all, remain wingless (Hagen and at other places, page 102); just as those described by Dr. Hagen as soldiers of the *Termes* (*Termopsis ?*) *occidentalis* Walker, and those of the *Calotermes smeathmanii*.

served many times, and were first described by Lespes particularly. The same difference is found among the nymphæ of *Termes lucifugus*, which he observed with two different forms in Bordeaux.

The nymphæ of the first form are livelier, thinner, and have long and broad wing beginnings quite covering the front part of the hinder body. They begin to color the first of May, and change themselves into winged animals between the 15th and 20th of May.

The nymphæ of the second form are more seldom found; they are thicker, more clumsy, and have small short wing beginnings placed sideways. In February, as Lespes first found them, these second nymphæ had the same size as the other (6 to 7 mm.); later they become larger (8 to 10 mm.); but the hinder part of the body grew considerably, particularly in the females. The rear part has grown so fast that the back shields do not continue to cover the sides, but become divided on top by a soft skin. With this swelling of the hinder body is correspondingly a stronger development of the procreative organs. The female nymphæ of the first form had shortly before the last moulting, in each ovary, perhaps twelve tubes, of which only two or three contained unripe eggs. On the contrary, with the nymphæ of the second form, were found as many as fifty-six tubes in which the eggs became visible with older nymphæ. Also the male procreative organs were much more developed in the second form, and the nymphæ outlive the transformation and the swarming of the others, and grew on as nymphæ. They only begin to turn brownish in July, and always become at this time more rare. The observations of Lespes unfortunately only reached to this season. He supposes that the nymphæ of the second form change to winged males and females, and swarm in August, and that out of them come forth a king and queen.

While the smaller couples of wingless males and females are derived from the nymphæ of the first form, these he sometimes found in the nests of *Termes lucifugus*, and called them "little kings and little queens." This conclusion is reached only on account of the development of the procreative parts of king and queen as compared to those with the nymphæ of the

second form, and the development of the procreative parts of the "little king and little queen," as compared with those of the nymphæ of the first form. These different magnitudes, and these different developments of the procreative organs of the captured kings and queens of Lespes may be explained by supposing that they belong to growths of the different years.

Dr. Hagen has already said—against this conclusion of Lespes—that in all kings and queens examined until now, the wing-scales show exactly the form and size of the imago. This development cannot be brought at all in harmony with the little rudimentary wing-cases of those nymphæ. It seems also improbable that these nymphæ with their last moulting may draw out of the rudimentary sheath only wing-scales. So much the more, as the scales of a royal pair every time show exactly the places from where the wings are broken. Besides, the prothorax of the queen never differs in form from that of imago; while the nymphæ of the second form are distinguished by a broader prothorax. When in July the nymphæ of the second form begin to turn brown, as their last moulting was near at hand, in case they had to undergo one, their wing beginnings were still so small that it was impossible that out of them could become developed wings such as those animals possess which swarm in May. Even if they would get such wings, they would not be able to fly on account of their thick hinder bodies, as every one will agree who has seen living Termites.

The observations of Robe-Moreau, beginning in 1797 (his memoirs on the Termites observed by Rochefort, etc., appeared 1843), and who has given long years of observation to the Termites in and around Rochefort, met "delayed nymphæ" after the swarming time, which he supposed did not undergo a further change, as a second swarming had never been observed in Rochefort.

Dr. Hagen thinks that Robe-Moreau and Lespes have examined the same species, while Lespes believes that the *Termes lucifugus* of Bordeaux are different from those of Rochefort. However it may be, it seems to me there is scarcely a doubt that in Bordeaux there does not take place a second swarming of

males and females derived from the nymphæ of the second form. That rather these nymphæ remain wingless, and never leave their nests in which they develop themselves under conditions into males which can beget offspring, and into females which can lay eggs. These nymphæ, like mature animals, are already observed with several species, and have been usually described as queens. Joly illustrated a queen of *Termes lucifugus*, without wing-cases, and Lespes reports that Joly assured him also that the same had been seen without a trace of wing-cases. Besides, Burmeister described a female of *Termes flavipes* as a wingless queen, and Dr. Hagen, who examined the same animal, found it had about the same habit as a queen with the short wing-sheaths of a nympha. He also considers Bates' queen of *Termes arenarius* as a nympha with undeveloped wing-sheaths. (Communicated by letter of January 2nd, 1872.)

Further, I take here in consideration a specimen of *Calotermes flavicollis* which is in the British Museum, described by Walker among *Termes lucifugus*, a nympha with short wing-cases, deceptively like an imago which has lost the wings. The uniform black color, the shining polished head, thorax and body, exclude the idea of another moulting. (Dr. Hagen 12, pages 20 and 59, and at other places.) Therefore the males and females of certain species of Termites appear under two different forms.

The ones arising out of the nymphæ of the first form receive wings, and leave their birthplace in swarms. Only very few lucky ones among them are so successful as to ascend later a vacated throne as king and queen. The others, which have become the matured nymphæ of the second form, never see the light of day; they remain wingless, and never leave the nest in which they have grown.[4] Of what importance is now the preservation and the success of the species of each one of these two forms? A large

[4] Dr. Hagen writes me that all queens (of *Termes bellicosus, dives, obesui, gilvus*) which he saw, from Asia and Africa, are really imagines with the wing-stumps from which the wings are broken. On the contrary, all queens (of *Termes flavipes, morio*(?) *similis*(?) *arenarius*) which he had seen from Brazil and America were decidedly nymphæ. So striking this fact may seem, it would be hasty judgment to conclude from it that in the occurring of both forms there exists a difference between the old and new worlds. I have seen here more than a hundred real queens, more than Dr. Hagen, from Asia and Africa, before I found for the first time nympha-like females.

Termite colony sends out yearly over a hundred thousand winged males and females, for the purpose of receiving back a single royal pair every two, three, or four years.

The destruction made among these quite defenceless animals are numerous, from man to the common ant. As the difficulties are so great after the bride and groom have selected each other, and reached the nest for which a royal pair is wanted,—would it not seem more simple and more sure to keep all males and females well protected at home? What an amount of work would the Termites be spared if they did not have to bring up, year after year, those cloud-like swarms of winged animals which ascend from the large hill-nests.[5]

Is it not striking that with all species, wherever they may exist, a simpler and surer way has not been found which should spare so much work, by developing through nympha-like males and females, by the way of natural selection?

Whenever one meets such questions, one may usually take Darwin, and hope to find the key of the solution. In this way, whoever occupies himself with this subject will find recorded in the 17th chapter of his book on "The Variation of Animals and Plants under Domestication," evidence which he will scarcely object to acknowledge has made in the highest degree probable, if not proved, the conclusion with which Darwin closes the chapter: "That the crossing of animals and plants which are not closely related to each other is highly beneficial, or even necessary, and that inter-breeding prolonged during many generations is highly injurious."

Now with the majority of the Termite species of which sociable conditions are known, every colony possesses, with rare exceptions, a single royal pair, or sometimes a single king with two consorts. Therefore all in this state are grown-up males and females, brothers and sisters. The exclusive propagation through indigenous

[5] Rengger, Tollin, and others have spoken of the building up of new colonies by the swarming males and females, and reached the idea therefore that swarming would be absolutely necessary. I will not directly deny the ability of the males and females of Calotermes to go on living further in their own way, and to begin a new settlement. With all species of Termes, Eutermes, Anoplotermes, of which the way of living I know to some degree, a winged pair would undertake the foundation of a new state with exactly the same success as a pair of new-born children which one had set out on a desert island.

males and females would lead to the most narrow and limited marrying into the same family. During the out-swarming the males and females of different colonies can find each other, whose union here, as elsewhere, will produce a stronger offspring.

With the numerous exterminations, through diverse enemies, which the Termites undergo while swarming, it will occur that a colony is not able to fill its throne in due time with a new royal pair, in spite of their infinite number. In this case of need nympha-like males and females, safely kept in the nest, step in as substitutes, and save the colony from becoming extinguished.

From the circumstance, that only then these reserved males and females become necessary, if no real royal pair has been found after the close of the swarming time, the delayed developments of the nymphæ of the second form may be explained. Lespes reports that these nymphæ of the second form always become more rare the nearer the time of their changing approaches (only supposed, not observed). Dr. Hagen reports of the work of Lespes (12, page 317, and other places), that it would be certainly highly strange if the same really changed into winged animals for a second swarming.

It seems comprehensible that they are gradually allowed to die out by starvation when not needed, or that only so many are kept alive as are necessary. In a surprising way these conditions exist alike in the Termites as in the plants of the most different amilies, in the observed facts of closed blossoms (cleistogami Kuhn).[6]

As there develop on certain plants, besides open ones, the cross-fertilizing blossoms of different plants, so others are found developed which never open themselves (cleistogama), of which the stamens and pistils always remain enclosed, and by which the preservation of the species becomes assured in case the fructification depending on outside conditions does not take place through open blossoms.

In the same way certain Termite colonies develop beside the out-swarming and crossing of different colonies, through other

[6] Compare Hildebrand, The Distribution of Sexes in Plants, 1867, page 73. Severin Axell, Fanerogama Vaxternas Fructifij, 1869, pages 19 to 76.

never-swarming (cleistogamic) males and females, which always remain locked up in stock, and through which the preservation of the species becomes assured, in case the fructification of out-swarming males and females, depending on the favor of outside conditions, does not take place.

As the cleistogamic blossoms of many plants are to young buds of the opened blossoms, so are the cleistogamic males and females of the Termites alike in reproduction to the out-swarming. With the plants the leaves of the flowers remain, with the Termites the wings remain, in a lower state of development. The lavish production of flower-pollen in open flowers corresponds with the lavish production of winged males and females; as the limited number of nymphæ with short wing beginnings to the more scanty pollen of cleistogamic blossoms. As the cleistogamic blossoms of the violet unfold to open ones, so in *Termes lucifugus* the nymphæ of the second form develop later than those of the first form.

In the foreign *Leersia oryzoides* in France, fructification has been so far only observed to take place by means of cleistogamic blossoms, so until now in the garden in Schönbrun only one cleistogamic female has been found of the *Termes flavipes*, probably because in both cases, in a strange land, the outside conditions are not favorable for the usual fructification.

I had formed this opinion about the nymphæ with short wing-cases, the same as that in Dr. Hagen's monograph, from the facts there laid down, and stated in letters, long before I had the opportunity to see such animals.

Unfortunately the real kernel of this standpoint lacked the real foundation,—the proof failed,—that really cleistogamic males and females took charge of the transplanting of the species in cases where king and queen failed in stock.

One will comprehend with what joyful surprise I greeted a discovery which allows me now to furnish this proof.

I had (on the 11th of November) brought home with me the firm kernel (of a Eutermes nest), about the size of a hen's egg, out of decayed Gissara stump. Around the kernel were heaped considerable masses of eggs, and so I expected to find therein,

as usual, a royal pair. But instead of a large royal room enclosed in the middle part, the whole kernel was as a sponge, with irregular ways leading all through it. In these passages sat here and there not less than thirty-one compensating females,—five or six pressed tight together, with short wing beginnings (Fig. 1); six or eight mm. long. Among them only a single king walked around, of nearly the same size, and indeed an actual king, with large black eyes, and the wings were broken off from the wing-scales.

A queen was lacking.

Instead of a royal palace in which a king lived in chaste matrimony with his equal consort, I had a harem before my eyes, in which a sultan satisfied himself with numerous coquettes.[7]

In course of a day these supplementary females laid a pretty large number of eggs, which were carried into little heaps by the workers. The same wave-like contractions, as with the queens, could be seen, and I saw with several the extrusion of an egg.

The color of these females with short wing beginnings is a light brown, by which they are distinguished, as much from the pale, nearly colorless workers, as from the great deal darker-colored king. As a whole they look pretty much like the workers, more alike than to any other forms of their kind, only they are twice as large. Their wing beginnings are with most of them too small to be noticed, by a not very careful observation. Their hinder body, only slightly swollen, has about the same oviform figure, and stands about in the same relation to the whole length as that of the worker. The likeness of the head (Fig. 2)

[7] It may be supposed that Bofinet had already seen a similar company of supplementary females of *Termes lucifugus*. There were seven of them in the middle of a beam or joist. They were eight by ten mm. long, nearly white or very light red. Near them were found several egg heaps and very numerous larvæ, enough therewith to fill a litre. Compare Dr. Hagen's report (10, page 130, and other places).

Lespes had found in *Termes lucifugus* only a single royal pair, and the bright color of those found by Bofinet is not characteristic of the real queens.

When Dr. Hagen (12, page 177, and other places) supposed that Lespes might have seen no queens at all, but only large nymphæ of the second form, contradicting the assurance of Lespes (page 332, and at other places), expressly accentuated by Joly, that the wing-scales of his queens were always present. In the different measurements by Bofinet, Joly, and Lespes I can find no objection, as the females only grow up gradually from that of the imago to the fabulous size which has made the queens of the Termites so celebrated, and one can find all the sizes that lie between.

is especially striking. The clear cross lines which generally distinguish the head of the Eutermes worker are with most of these females scarcely less distinct than with the workers. (Hagen 12, page 187, and at other places). The antennæ have fourteen joints, as those of the worker, while the soldiers have but thirteen, and the winged animals have fifteen. The head could be taken for that of a worker if it were not for their little round faceted eyes, which, however, are scarcely raised above their surroundings, and are somewhat a slightly darker color.

I have not observed ocelli. The prothorax resembles that of the worker—it has a saddle-formed depression, going cross-wise, which separates a forward flap, and this flap is very large with the worker, steep, turned upwards, and not deeply carved in the middle of its front edge. With the supplementary females it is only small, and was simply rounded off, and goes up slightly. The size of the forward lap changes, however, with some few samples, and it was reproduced by a small seam, and then the prothorax resembled that of the king. The wing beginnings take the whole lateral borders of the meso- and meta-thorax (Pl. XXXIV., A); mostly they are scarcely half so long as these body wings, broad and then triangular, horizontal to the outside directed projections of which the forward edge goes obliquely to the background; with very few samples (Pl. XXXIV., B) the wing beginnings are considerably longer; also the meso- and meta-thorax are in this case a great deal more strongly developed. The oblique to reverted wing beginnings cover the forward edge of the hinder ones. The belly shields are formed as with the winged females. The internal reproductive organs (Fig. 3) are nearly like those of the winged females, for the reason that they hold eggs. Every ovary seems to have about half a dozen, and the egg-tubes about a dozen, for every ovary (the number seems to be rather variable), and are placed in clusters, as with the winged females, on the end of a short oviduct, while with the full-grown queen every ovary forms a long tube, that in the whole length is covered thickly with extraordinary numbers of egg-tubes. The seed pocket and albumen glands have the usual

form. A queen 19 mm. long, which weighed about 0.2 grammes, is equal in weight to fifteen supplementary females. The ovaries of all the thirty-one supplementary females may together scarcely weigh as much, and furnish hardly as many eggs, as those of a single older queen.

Lespes and Dr. Hagen also found male nymphæ with short wing beginnings, so the king may probably just as well be substituted by supplementary males as the queen by supplementary females. Does such a substitution take place in a nest at the same time for both sexes? out of those eggs of the supplementary females fertilized by the supplementary males develop all forms which compose the Termite population? or are only workers and soldiers; and are, of all species, in all colonies, regularly each year, nymphæ with short wing beginnings produced?

These are questions which I cannot answer now with certainty. The exact solution may require observations continued for years.

Supplement.—Bates, Lespes, and also myself found the youngest larvæ of the different classes occurring in the Termite family undistinguishable.

Before they reach half the length of the grown-up worker, they separate themselves by the first indication of the wing-cases.

From the larvæ of the later, able to become reproducing animals, those of the soldiers and workers are distinguished by their thicker heads, as also in *Termes saliens* and others.

Only a short time before the last moulting are the larvæ of the soldiers distinguishable from those of the workers, however different both may be in grown-up condition. A single exception only has been observed by Bonifit of a soldier which was so small that it as such seemed to have left the egg.

If the difference in sexes is not taken into consideration, that of the two-fold forms of the workers and soldiers which seems to occur with some species, may be expressed in the following statement which is made for the Termite states (or colonies) of the species Termes and Eutermes.

PLATE XXXIV.

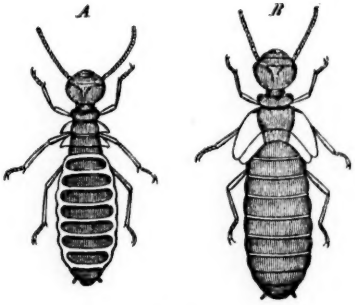


Fig. 1.

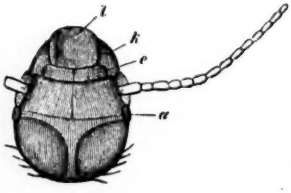
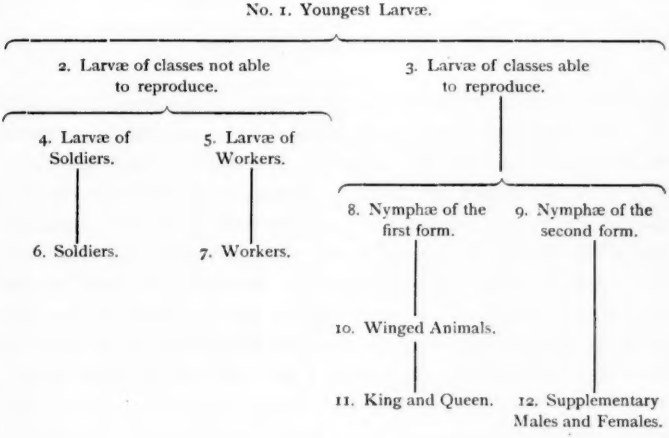


Fig. 2.

Fig. 3.

Termes lucifugus.

TABLE OF DEVELOPMENT.


No. 1. Youngest Larvæ.
2. Larvæ of classes not able to reproduce.
3. Larvæ of classes able to reproduce.
4. Larvæ of Soldiers.
5. Larvæ of Workers.
6. Soldiers.
7. Workers.
8. Nymphæ of the first form.
9. Nymphæ of the second form.
10. Winged Animals.
11. King and Queen.
12. Supplementary Males and Females.

DESCRIPTION OF PLATE XXXIV.

FIG. 1.—Two compensating females of *Termes lucifugus*. *A*, The usual form, with short wing beginnings; *B*, the more uncommon form, with longer wing beginnings.

FIG. 2.—Head of a compensating (or supplementary) female. *a*, Both small faceted eyes; *l*, the upper lip; *k*, the upper jaw.

FIG. 3.—Sexual parts of a compensating (or supplementary) female; *s*, semen pocket; *k*, albumen glands.

STUDIES OF PELECYPODA.

BY ROBERT TRACY JACKSON.

THIS paper is a brief summary of some of the more important and interesting facts and conclusions contained in a paper recently published by the author.[1] The leading principles employed in the paper are two: I. Professors Cope's and Hyatt's theory of the acceleration of development, with its corollary that in the young, stages are found, the equivalents of which are to be sought in the adults of ancestral groups. II. That in the mechanical conditions of environment and a study of the life-habits of animals, facts may be gathered which will throw light on the origin and meaning of external and internal anatomical features.[2] In accordance with the above principles, young and adults, living and fossil species of many allied genera were taken up as one common study.

The completed embryonic shell of Pelecypods differs from and is commonly sharply marked off from the succeeding shell growth. This embryonic shell is compared to the protoconch of cephalous molluscs, and as it is bivalved it is termed a prodissoconch. Carrying out the same terminology, the succeeding shell growth is termed a dissoconch. In my paper a prodissoconch is described, or at least mentioned, as existing in thirty-nine genera of Pelecypods.

Prof. Hyatt's classification of stages of growth and decline[3] is considered at length in its application to the Mollusca. Some alterations in that valuable classification were deemed necessary, and are introduced.

[1] Phylogeny of the Pelecypoda, the Aviculidæ, and Their Allies. Mem. Bost. Soc. Nat. Hist., Vol. IV., No. 8, July, 1890, pp. 277–400, Pls. XXIII.–XXX.

[2] In a paper soon to be published in this journal, I consider some cases of the mechanical origin of structures in Pelecypods.

[3] See this journal for October, 1888.

The development of the oyster is followed from the egg up to the adult. It is a highly modified Pelecypod, and has a very accelerated development. The completed prodissoconch stage of Ostrea (Fig. 1) is an important period in development, and yields facts of much phylogenetic significance. Two adductor muscles exist instead of one, as in earlier and later stages. No foot, but filamentous gills, a velum, and a plain mantle border exist. The anus overlies the posterior adductor muscle, and the velum and mouth lie on the ventral border of the anterior adductor, the normal condition in dimyarian Pelecypods. The larval umbos are directed posteriorly, —a fact of some significance. In all Pelecypods apparently, as in Ostrea, the anterior adductor is developed first, both muscles always being present, as far as known, at the completed prodissoconch stage.

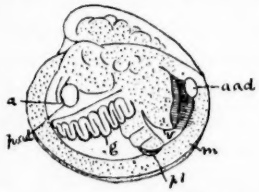


FIG. 1.—*Ostrea virginiana; a ad, p ad*, anterior and posterior adductor muscles; *g*, gills; *v*, velum; *pl*, palps; *a*, anus; *m*, mantle border. X 90 diam.

In the nepionic stages, which succeed the prodissoconch, changes take place rapidly. Fig. 2 is the same specimen as Fig. 1, but three days older. The anterior adductor muscle has disappeared, and the gill filaments are connected ventrally by cross-connecting bars. Later the antero-posterior axis becomes revolved, so that the mouth parts are directed toward the hinge line. An intricate system of cross-connecting bars is built up between the gill filaments, until we find the condition characteristic of the adult. Whereas but a single pair of gills exists in early stages, later two new gills originate, one on the outer side of each previously formed gill. The new gills do not originate simultaneously, but there is a considerable interval, which forms a three-gilled period.

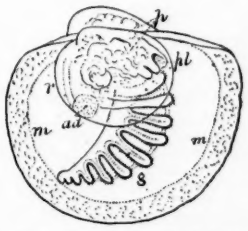


FIG. 2.—*Ostrea virginiana; pl*, palps; *ad*, adductor muscle; *r*, rectum; *g*, gills; *m*, mantle border; *p*, prodissoconch.

There are four distinct periods in the development of the shell of Ostrea: I. The phylembryo[4] stage, with saucer-shaped valves, a straight hinge line, and but slightly developed umbos. II. The completed prodissoconch (Fig. 3), with a curved hinge line, well-developed umbos, nearly equal valves, and without prismatic cellular structure. In *Ostrea edulis* there are teeth similar to those of Nucula on the hinge line of the prodissoconch, but none exist in *O. virginiana.* III. The nepionic period (Fig. 4), with a flat attached and convex free valve. The triangular cartilage pit of Ostrea originates in the initial nepionic stages on the border of the prodissoconch valve (Fig. 5). The right valve of this period has a well-defined prismatic layer. IV. The adult, in which the attached valve is concave and the free valve is flat.

FIG. 3. — Prodissoconch stages of *Ostrea virginiana; l*, left, and *r* right valve.

In the Ostreidæ[5] the striking peculiarity of the shell is that the valves are unequal, and also dissimilar. This character is ascribed to the mechanical effects of the condition of cemented

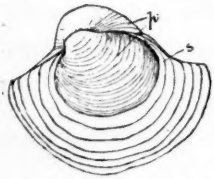


FIG. 4.—*Ostrea virginiana; p*, prodissoconch; *s*, spat or nepionic growth.

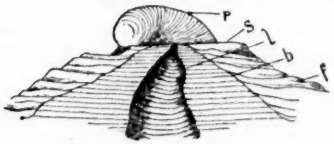


FIG. 5.—*Ostrea virginiana;* tip of left valve; *p*, prodissoconch; *s*, spat or nepionic growth; *l*, cartilage pit; *b*, flange-like extension of shell over object of support.

fixation acting on a Pelecypod shell. This conclusion is of great value in tracing the genetic relations of attached forms. Differences in the two valves of attached forms may be seen in Spondylus, Hinnites, Mulleria, the Chamidæ, Rudistæ, etc. There is abundant proof that the form is due to the condition of fixation, and not to gravity, as has been maintained. The form induced

[4] A new term, designating an early embryonic stage, yet which is advanced enough to show the characteristics of the class or phylum to which the embryo belongs.

[5] In my paper it is spelled Ostreadæ. In deference to rule, as a family name it should have been spelled as above. See Proc. Am. Ass. Adv. Sc., Aug., 1877.

by cemented fixation is a concave attached valve, a flatter and commonly thinner free valve, an irregularity and assymmetry of growth tending to the displacement of characters normally found in near allies, and, as a general thing, a camerated structure of the shell. The fullest modification in this line of variation is the production of a shell in which the attached valve is cup-shaped, conical, or subcylindrical, as seen in the Chamidæ and Rudistæ. In this group as a whole, and in the progressive stages of growth of its extremest members, all transitions may be followed between a simple ostreiform or exogyriform shell and the most highly modified conical type. The Ostrea form is the first step in this line of variation, the Exogyra form is the second step, and the Hippurite form is the last step. The equal impact of moving water on all sides of the attached organism is believed to be the chief factor in inducing this form, but aided by correlated forces as briefly discussed in my paper.

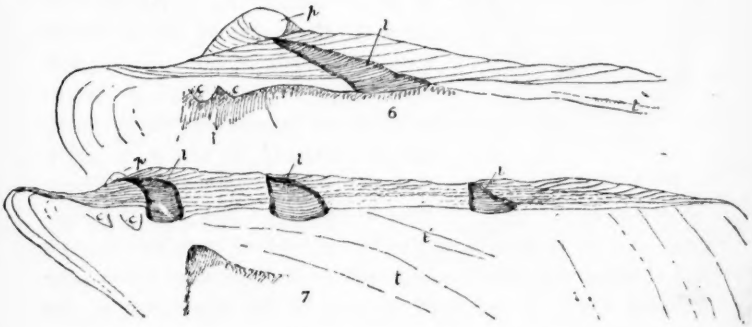


FIG. 6.—Young *Perna ephippium*, right valve; *p*, prodissoconch; *l*, cartilage pit; *c*, cardinal, and *t*, lateral, teeth. X 90 diam.

FIG. 7.—*Perna ephippium*, older than Fig. 6, with several cartilage pits; lettering as above. X 24 diam.

It is considered that Ostrea probably descended from Perna, or a close common ancestor of the two genera. The bases of likeness are the anatomy of the soft parts, shell structure, the prodissoconch, and other features in the development of both genera. The differences are mainly ascribed to the effects of the condition of fixation in Ostrea.

Perna has a prodissoconch closely like that of Ostrea. The byssal sinus originates in the initial stages of dissoconch growth. In young Perna (Fig. 6) a single triangular cartilage pit exists as in Ostrea. In later growth new pits originate on the ligamental line (Fig. 7). They, too, are triangular at first, but when the sides of the triangles have attained a certain degree of divergence they are produced perpendicularly, which is the condition found in the adult. The nepionic stage of Perna (Fig. 8) is subrhombic in form, and the anterior auricle descends directly from the limits of the prodissoconch. The form of this stage is comparable to that found in early Paleozoic Aviculoids. It is compared to *Rhombopteria glabra* sp. Barr., from the Silurian.

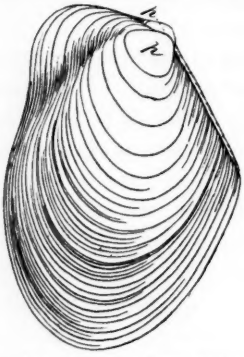


FIG. 8.—Young *Perna ephippium*; *p*, prodissoconch. X about 37 diam.

In Avicula we find a prodissoconch like that of Perna and Ostrea, and, as in those genera, it is traceable in origin to the nuculoid radical which forms the basis of our genealogical table. The nepionic stage of Avicula (Fig. 9) is subrhombic in form, and is referable in origin to early Aviculoids. It is compared to *Rhombopteria mira* (Fig. 16), from the Silurian. A later stage of Avicula (Fig. 10) differs from the nepionic and adult periods, and is comparable to the Devonian genus Leptodesma, which is the third step up in the phylogeny of the Avicula series.

A prodissoconch and nepionic stage similar to those of Avicula are described in many allied genera, which are Meleagrina, Monotis, Pseudomonotis, Oxytoma, Cassianella, and Vulsella.

Pecten irradians presents an interesting subject for study. Its life-habits are varied and striking. Its stages in growth, both in the soft parts and the hard, present a remarkable series of high phylogenetic significance. At the completed prodissoconch stage Pecten is doubtless dimyarian, and crawls on the ventral border of the valves by means of an active foot. It may also have a

velum at that stage, and be capable of swimming by means of that organ. In the nepionic stage the foot is of relatively great size, mobile and prehensile. It extends through a special notch in the right valve (Fig. 12), this being the side on which the foot exerts pressure in the act of crawling. This notch is a necessary mechanical consequence of the conditions of the case. At a later stage in Pecten we find that the early free crawling condition is abandoned, and the animal adopts the habit of byssal fixation, which is more or less adhered to until the animal is two to three centimetres in height; but was not observed in adult *Pecten irradians*.[6] Although the swimming habit of *Pecten irradians* is

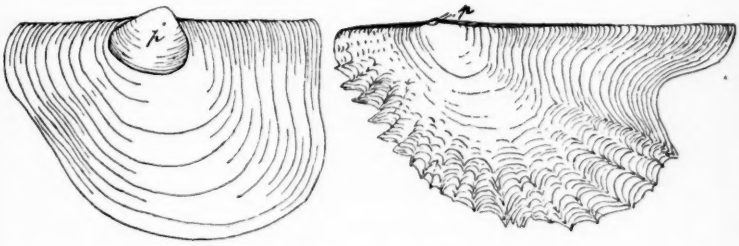


FIG. 9.—Young *Avicula sterna*, umbonal area of valve, showing (p) prodissoconch and succeeding nepionic growth.

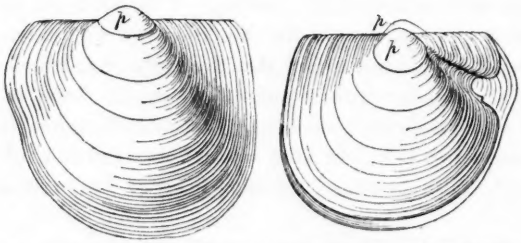
FIG. 10.—Young *Avicula sterna*, showing later stage of growth.

more or less exercised from the nepionic stages up, it is essentially the life-habit of the adult, for then the crawling and byssal habits are abandoned and the foot is atrophied. The swimming of Pecten is most active, and in the anatomy we find a most perfect adaptation of parts to the requirements of this peculiar habit.

In the shell of Pecten (Figs. 11, 12) the prodissoconch is sharply defined, as in the genera already mentioned. It is directly referable in shell structure and in the inferred soft parts to to the nuculoid radical of the group. The nepionic stage (Figs. 11, 12), is subrhombic in form, has no ears, and is a very striking period of growth. The right valve has a byssal sinus which originates with the nepionic stage as in Perna and Avicula, and a tooth exists on the margin of the notch. This stage is closely

[6] I recently dredged near Eastport, Me., adult specimens of *Chlamys islandica* which were attached by a byssus.

like the same stage of Perna (Fig 8) and Avicula (Fig. 9), and is traceable in origin to the same ancestral type, Rhombopteria (Fig. 16). The right valve of this stage of Pecten possesses a well-defined layer of prismatic tissue, though it is early lost.



FIGS. 11, 12.—Young *Pecten irradians*, viewed from the left and right sides; *p*, prodissoconch. X about 37 diam.

This is a good example of accelerated development, for prismatic tissue is characteristic of the adults of the Aviculidæ, from which group the Pectinidæ were derived.

In a later stage of growth of Pecten (Fig. 13) we find im-

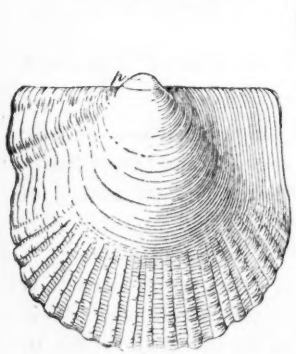


FIG. 13.—Young *Pecten irradians; p*, prodissoconch. X 30 diam.

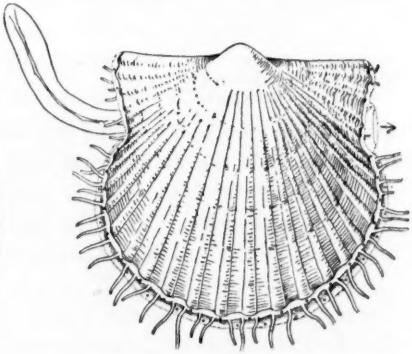


FIG. 14.—*Pecten irradians*, still older; showing foot, tentacles, eyes, and excurrent pseudosiphon. X 12 diam.

portant changes in form, which mark the beginning of features characteristic of the family. The hinge line is longer and terminated by slightly developed ears, plications originate in both valves, and the byssal notch is strongly marked. This stage is referable

in origin to Pterinopecten, a Devonian genus which is adopted as the base of the family of the Pectinidæ. At a still later stage (Fig. 14), the hinge line is relatively shorter than in Fig. 13, yet longer than in the adult. The ears are well pronounced. This stage is comparable to Aviculopecten (as amended by Prof. James Hall), which is the second step in the Pecten series.

Similar stages to those described in *Pecten irradians* have been observed in several other species. In the young of *Pecten magellanicus* there is ornamentation of the shell strikingly like that seen frequently in Aviculopecten.

Hinnites is pecteniform in its nealogic stage, and shows graphically the change in form induced when it becomes attached and assumes the ostrean features characteristic of the adult. Spondylus has a prodissoconch like Pecten, and in its nepionic stage is pecteniform as observed in five species, proving its origin in that group. It early becomes attached and assumes the ostrean form. Plicatula becomes attached at the close of the prodissoconch stage, and at once assumes the ostrean form; thus as in Ostrea nepionic characters are eradicated which might, if existent, show distinct phylogenetic stages. It is the furthest removed from Pecten of its series, because it earliest and most completely assumes the ostrean form.

In Anomia the form of shell and peculiarities in the soft parts may fairly be ascribed to adaptation to the environment, rather than to genetic connections of the group. In the early nepionic stage Anomia is freely locomotive, with a highly active foot. At this age byssal attachment is voluntary, and is frequently abandoned. The relations of the muscles, which are ambiguous in the adult, are clear in the young. The calcareous plug is composed of consolidated parallel ridges of lime. In the young these ridges are seen to be made up by the amalgamation of calcareous discoid points. The several points are directly comparable to the discoid points of fixation of the byssal threads in Pecten, Mytilus, etc. The prodissoconch of Anomia is described in two species. It differs from the prodissoconch of the previously mentioned genera in possessing a slight byssal sinus in one or both valves, according to the species, thus showing a very accelerated develop-

ment. During the nepionic stage the byssus becomes enclosed by progressive deepening of the byssal sinus and circular growth of the right valve. In later growth extensive resorption of the shell progressively enlarges the byssal foramen. The right valve of *Anomia glabra* is thinner than the left valve, and differs also in being almost entirely composed of prismatic tissue.

In the section "Studies of a Few Other Genera" the young of Pelecypods more or less remotely separated from the Aviculidæ are considered. In these genera the umbos of the prodissoconch are directed anteriorly relatively to the larval anatomy, excepting in Nucula, Tellina, and the Unionidæ, in which last group umbos are not developed. In all genera excepting the Unionidæ the nepionic stage does not have a prismatic layer. In genera of the Aviculidæ and allies, on the contrary, we find the umbos of the prodissoconch are directed posteriorly relatively to the larval anatomy (Fig. 1), and the nepionic stage has a layer of prismatic tissue, although this may disappear in later growth.

In genera of the Mytilidæ and Arcidæ we find a well-defined prodissoconch and nepionic stages, which are traceable to ancient fossil representatives of the families. In three genera of the Unionidæ studied the completed prodissoconch is of the same size and form as the glochidial stage. In structure it has not progressed beyond a modified condition of the phylembryonic stage. It is a specialized type, owing its peculiarities apparently to parasitism and correlated larval adaptation. A prodissoconch and nepionic stages are described in Echinochama, Sphærium, Petricola, Venus, Tottenia, Scrobicularia, and Saxicava. The prodissoconch is mentioned without description in a few other genera. In *Mya arenaria* a considerable description is given of the byssal habit, development of the siphon, and the shell. These present features of phylogenetic interest.

In the development of the shell of Pelecypods the phylembryonic stage has a straight hinge line, which apparently represents a primitive condition common to the whole class. This form appears to be the natural mechanical outcome of its derivation from a primitive univalvular ancestral type. The next step in the development of the Pelecypod shell is the curving of the

hinge line, the centralization of connecting tissue and teeth in the middle of the hinge line, and the development of umbos.

The characters described in the prodissoconch of the Aviculidæ and their allies are found combined in a remarkable degree in the ancient genus Nucula, which, though living to-day, extends back to early Paleozoic formations. It is probable that Nucula, or a nuculoid form, is the type we are seeking as the ancestral radical represented by the completed prodissoconch in the development of Avicula, Perna, Ostrea, Pecten, and their allies. The fact that Nucula is found in the Lower Silurian, and still lives without sufficient changes in form to make these extremely separable forms in time generically separable, argues for a high antiquity for this genus. It was so firmly established in its earliest-known forms, it must at that time have been an ancient genus.

The nepionic stages of Avicula, Perna, and Pecten (Figs. 8, 9, and 11) agree closely in form, and are referable to an early, simple aviculoid type, Rhombopteria (Fig. 16). Therefore, that genus is adopted as the basis of the Aviculidæ, being the first step up from the nuculoid radical of the group. From Rhombopteria, Leptodesma leads up to Avicula, forming the central stock of the family. From the Avicula stock many side issues arise, as Meleagrina, Pseudomonotis, Cassianella, Malleus, and others. These are like Avicula (Fig. 9) in the nepionic stage, but in later growth depart from the typical form of the stock. Perna is an important issue from Avicula, which it resembles in the nepionic stage. Gervillia and the Inoceramus group are modified forms from the Perna stock. The Ostreidæ are considered a modified branch from the Perna stock, which owes its peculiar features chiefly to the effects of fixation. Ostrea is the base of its group, and Exogyra the extreme, because it is the most highly modified by the adopted habit of attachment.

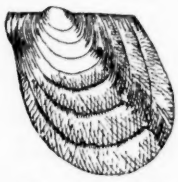


FIG. 16.— *Rhombopteria*[7] *mira* sp. Barr. Upper Silurian (after Barrande).

[7] A new genus, proposed in my paper for an ancient simple group of aviculoid shells.

From Leptodesma-like forms the Pinnidæ are probably derived. This is considered a degradational group on account of the high development of the anterior adductor (a larval character), prismatic structure, and other peculiarities of some members. The Pterinea group is considered a side issue from the Rhombopteria stock. Pterinopecten is an important branch from the Rhombopteria stock. In the young it closely resembles Rhombopteria. It forms the base of the Pecten series. Aviculopecten is the next ascendant step in the Pecten series. In stages of growth it resembles, first, Rhombopteria; second, Pterinopecten. Pecten, the representative of the family, is the summit of the stock. As we have shown, the prodissoconch resembles the nuculoid radical. The first nepionic stage resembles Rhombopteria; the second and third nepionic stages, resemble respectively Pterinopecten and Aviculopecten. Lyriopecten and Crenipecten are considered side issues from Aviculopecten. From the Pecten stock important issues are given off. These are the Hinnites, Lima, Amusium, Anomia, and Dimya groups.

The phylogenetic relations of the Aviculidæ and allies are considered in more or less detail in the last section of my paper, which is closed by a tabular view representing graphically the various genetic relations expressed.

ANNELID DESCENT: THE ORIGIN OF METAMERISM AND THE SIGNIFICANCE OF THE MESODERM.[1]

BY EDUARD MEYER.

THE recent publication by Claus of a paper "On the Morphological and Phylogenetic Significance of the Body of the Tapeworm"[2] has induced me to defer no longer the long-entertained and elaborated conception of the origin of metamerism amongst Annelids, and thus amongst all segmented Bilateralia, but to communicate to my fellow-workers, provisionally at least, a general sketch of it.

Claus, in the paper quoted above, refuting the conception of the tapeworm as a colony due to strobilation, brings forward evidence that the segmented Cestode body is to be derived from a non-segmented form in which, at first, the internal organs (sexual organs) appeared in metameric sequence, and later a corresponding external segmentation was introduced. This has finally attained a maximum in the superlative individualization of pieces of the body that separate completely from it in the formation of proglottids.

In my opinion, the Annelids owe the metamerism of their bodies to a process quite analogous, which here has produced a certain, but never, indeed, a complete, individualization of the segment, and which in some cases has finally degenerated into a non-sexual reproduction by fission.

This last phenomenon, in which I can see, when occurring in the higher Metazoa, a considerable degree of degradation, is often used as an argument in favor of their hypothesis by the supporters of the doctrine that animal segmentation had its origin in budding. We should not forget, however, that reproduction by fission among the Annelids has either been observed in only such forms as have a structure implying undoubtedly not primary but degen-

[1] Translated by Dr. E. A. Andrews from the *Biologisches Centralblatt*, X., July, 1890.

[2] Arbeit. a. d. zool. Inst. Wien, VIII., 1889.

erate simplicity of structure, or (where it occurs in the less simple members of the class) appears as the almost mechanical separation of part of the body, tending to destroy the general equilibrium by the collection of sexual products. The formation of a new head in this process can only be regarded as a phenomenon of regeneration that has been thrown back into earlier periods in consequence of the regular repetition of the process of fission from generation to generation, and that finally begins in a period when the separating part is still connected with the parent.

Moreover, if metamerism in segmented animals had originally arisen from the formation of buds, then, in the first place, the production of new segments must always take place at the extreme end of the body, or, in other words, the terminal section should be always the most recently formed metamere; and, in the second place, the entire body must consist of completely equivalent, consecutive pieces. In place of this we see, however, that the new segments arise from a formative zone anterior to the telson, that the telson belongs to the oldest part of the animal, and that all parts of the body do not correspond, since neither the cephalic lobe with the buccal zone and foregut, nor the terminal piece with the hindgut, can be compared with the metameres lying between them. If we derive the origin of metamerism from the kind of strobilation found in Acalephs, then the youngest segments follow immediately upon the first body segment, which (though occurring in the segmented Cestodes) is not at all the case in all other segmented animals from the Annelids up.

The heteronomy of prostomium, trunk segments, and telson, becomes intelligible, nay necessary, when we regard the metameres as arising from the segmentation of the trunk between the head and tail pieces,—that is, as arising in situ. How may this process have been effected in phylogeny?

The acquisitions of recent years indicate with considerable certainty that all segmented animals, omitting the Cestodes, have descended directly or indirectly from Annelids, and thus in them or in their immediate ancestors the formation of metameres had its origin. As long as these ancestors are regarded as trochospheres or medusa-like creatures (Hatschek, Kleinenberg), or if the Anne-

lids are regarded as descended from Echinoderms, as has been done (R. Wagner), we can scarcely come nearer to the solution of the above question, since we are driven to resort either to budding, strobilation, or to circumlocutions, such as "intermittently progressive processes of growth and differentiation." We will, I believe, arrive much sooner at the goal if we derive the Annelids from Planarian-like ancestors, for which the development, especially the differentation of the mesoderm, gives ample ground.

We find in Annelids, typically, as a chief constituent of the mesoderm, the two mesoderm-bands growing forward from two pole-cells. These bands, at first solid strands, subsequently break up, in the trunk, into the paired mesodermic somites, which become hollowed out and give rise to the definitive body-cavity; this constitutes the so-called secondary mesoderm. Besides this, larvæ as well as embryos of Annelids have a "primary" mesoderm, which not only functions in the larva before the formation of the mesoderm-bands, but also furnishes a considerable part of the permanent organs. To the former category belong the various simple muscles and the excretory organs of the larva; to the latter also a number of muscles, namely, the circular muscles, the transverse muscles, the muscles of the setæ sacs, septa, and mesenteries, the special muscles of the various parts of the digestive tract, also the retro-peritoneal connective tissue whenever it is formed, and in certain cases the excretory part of the definitive nephridia, which I have called the nephridial tube. Such a state of things I have established as existing in various Polychæte larvæ, and the same may be inferred with tolerable certainty from many statements in the literature, though the interpretations there are manifoldly different. The distinction between the *primary mesoderm*, or *embryonic mesenchym*, as it might be better called, and the *secondary* or *cœlomic mesoderm*, appears most plainly when a spacious primary body-cavity occurs between the ectoderm and the entoderm, separating the parietal mesenchym next the skin from the mesoderm-band next the digestive tract. As an example of this I would cite the larva of Psygmobranchus.[3]

[3] See Pls. 23 and 24 in Mitth. Zool. Station Neapel, VIII., 1888. I have there called the element of the primary mesoderm "parenchyma," from consideration of the possible reference to the corresponding tissue of the Turbellarians. As, however, this designation carries with it the idea of a more compact tissue, it is thus not quite a fitting one, and so I return to the old name, "mesenchym"

At the period when the mesoderm-bands are dividing into segments the mesenchym elements have so far increased throughout the entire trunk as to fill out completely the space between ectoderm and entoderm, not occupied by those bands. At the same time a portion (subsequently the septal and mesenterial muscles) penetrates between the mesodermal segments, thus leading to the division of the mesoderm-bands. This fact is also to be observed, that the external follows the internal segmentation of the body. At this stage in development, the similarity between the mesodermal structures of the young Annelid and those of an adult Turbellarian cannot be doubted. In the latter, as in the former, we find between the skin and the intestine cell aggregates, either solid or becoming hollowed out; in the latter the sexual organs, in the former the mesoderm somites (while in both the head region remains free from such structures).[4] The structures in Annelids and Turbellarians here compared are, in my opinion, really genetically connected. All the mesenchym structures in the Annelid, both in larval and adult stages, may be compared with quite similar structures in the parenchyma of the Turbellarian; the paired, metameric, peritoneal sacs, arising from the mesoderm somites, enclosing the body-cavity and producing the sexual products in definite areas, may be regarded as sexual follicles, with much enlarged cavities and manifoldly differentiated walls.[5]

In place of a more detailed demonstration, I will here give a preliminary sketch of my views on the phylogenetic development of the Annelid, such as I gave at the last (eighth) Congress of Naturalists, at St. Petersburg, January, 1890.

[4] In the Annelid the cephalic lobe does not possess any mesoderm segment of its own, but, as I have repeatedly convinced myself, receives its peritoneal lining from the growth of the walls of the first post-oral pair of somites,—that is, the first pair of the trunk. In this process the primitive head-cavity is completely obliterated.

[5] After Hatschek had expressed the idea that "the secondary body-cavity is comparable to the cavity of the sexual glands in lower forms," R. S. Berg endeavored to derive the peritoneal segment cavities of Annelids from the sexual follicles of the Nemerteans, but soon completely renounced this "working hypothesis" in favor of Kleinenberg's recent interpretation of the mesoderm. I had conceived, in the main, the views here presented before the publication of this opinion of Berg's, and have as yet learned no valid reason for changing my mind.

I imagine the ancestors of Annelids to have been powerful, predatory Turbellarians, which lived a pelagic life, and were at that time masters of the seas. By their agility in swimming and in catching their prey these forms were distinguished from their present non-parasitic relatives, the Planarians; and only such acquirements could, in my opinion, have led to a perfection of organization in an ascending direction. The Planarians were forced to the sea bottom to take refuge amongst rocks and plants, first by these ancestors, then by their favored younger relatives, the Annelids, and finally by fish and other predatory marine animals. Here they led a creeping life, and thence gradually acquired a flat, broad body, with irregular arrangement of the internal organs. The ancestors had an elongated body, rounded in section and very supple; so that these may have borne a resemblance to the Nemerteans. Yet the Annelids cannot be derived from these worms, since they undoubtedly form a side branch, subsequently much changed and distinguished by peculiar characters (proboscis, vascular system, excretory organs). Yet these have preserved some of the internal organization derived from those common pelagic ancestors, which may give us very valuable hints in considering the Annelid body.

In the body parenchyma, partly surrounded by, partly penetrated by powerful muscle systems, were the sexual glands, appearing originally in the immature state as a single pair of compact cell-bands, but in the mature condition as long, hollow tubes, opening externally at the posterior end of the body by a pair of simple dermal pores. It is conceivable that these organs, being distended with eggs or sperm at certain times, would much interfere with the flexibility of the entire body. Now, however, in consequence of this very rigidity produced by the excessive accumulation of sexual products, they would finally yield to the constantly repeated endeavors of the animal to regain its accustomed mobility, and divide up into smaller glands. Thus it would have been the serpentine swimming motions (by which alone we can imagine the rapid change of place of a long worm in the water) of the Turbellarian-like ancestors of the Annelids which caused the disintegration of the two originally uniform, elonga-

ted genital tubes into two rows of equal segments. In this process, very probably, certain muscular regions, especially those parts of the transverse and dorso-ventral systems serving in that mode of motion, took active part during their contraction by continually constricting the undivided genital glands.

The series of successive sexual glands thus arising, and arranged symmetrically on both sides of the intestinal canal for the maintenance of equilibrium, now furnished internal metameric centres, about which the remaining organs, which were previously diffusely distributed in and on the body, also grouped themselves metamerically. This I regard as having taken place as follows: In the gradual increase of thickness and firmness of the skin, or perhaps merely from the secretion of a cuticula of little elasticity; and again in consequence of serpentine swimming movements, circular furrows were formed upon the surface, where the integument was thinner. The sexual follicles, swelling at maturity, and so distending the body at equal intervals, would predetermine definite places for occurrence of these furrows,—that is, between two successive pairs of sexual glands. In the segmented body-zones thus marked out each somewhat centrally placed pair of the remaining organs acquired greater perfection, and thus rendered all its homologues superfluous in its segment, so that these gradually underwent complete degeneration. This, in my opinion, was the origin of metamerism.[6]

The cavities of the parenchyma probably first united into a large sinus about the intestine, from which lymph penetrated into the interior of the paired metameric sexual glands to nourish the developing sexual products floating in them. As this increased in quantity the follicular cavities expanded more and more, and in this way became transformed into the secondary body-cavity with its paired, segmentally arranged chambers. In the epithelial walls only certain areas, subsequently the sexual glands proper

[6] While writing this the recent "Lehrbuch der vergleichenden Entwicklungsgeschichte der Wirbellosen Tiere" of E. Korschelt and K. Heider came into my hands, and in it also the idea is advanced that "by terminal growth first an elongated, non-segmented ancestral form was reached, and then the entire body divided up simultaneously into a large number of segments by a rearrangement of the separate organs." In their opinion, also, the "serpentine motions" gave rise to such a process, since they must have led to the formation in the body of "alternating regions of greater and less mobility."

of the Annelid, retained the ability to produce egg or sperm mother cells; while the remainder, at first a sort of indifferent follicular epithelium, was pressed against the internal organs and tissues, and finally surrounded them in the form of a peritoneum. In this process the hæmal and neural mesenteries and the septa came into existence, as the previously existing dorso-ventral parenchym muscles became enclosed between the median walls of a pair of segmental cavities, and between the anterior and posterior walls of two successive ones.

The greater part of the primary body-cavity, consisting in the ancestral forms presumably of a lymph system of irregular holes and clefts in the parenchyma, was filled up for the most part by the expansion of the sexual follicles. Only a small part of it remained as the definitive vascular system. Since the cœlom sacs at first were rounded, they would not apply their walls immediately to the entire surface of the intestine, skin and to one another, but would leave open certain definite spaces,—namely, intersegmental circular spaces, lying transversely beneath the integument; a median space above and below the intestine, communicating each with the circular space, and lying between the right and left lamellæ of the mesentery. Joined to these there was also the above-mentioned intestinal sinus. Thus the method of origin of the segmented secondary body-cavity depicted above would at the same time have led to the formation of the chief portions of the vascular system, as a naturally resulting consequence of the given spacial relations.

Among the peritoneal structures of the Annelids, the neural and hæmal longitudinal muscles require special attention from the difficulty of divining the causes of their first appearance. I have formed the following as yet very hypothetical conceptions of these causes. Part of the non-reproductive elements of the wall of the sexual gland I regard as epithelio-muscle cells, the bodies of which were in the epithelial layer of the follicle wall, while the distal parts elongated as fibrils at each end and tangential to the surface of the gland, when contracting exercised pressure upon the contents of the follicle cavity (were thus functional originally in the discharge of the sexual products). After the

follicle walls had applied themselves to the integument and to the intestine, and had adhered to them, these follicle-muscles could no longer function as such, and disappeared, except in the familiar longitudinal areas on the external body-wall, where they at first strengthened the primary longitudinal musculature, and later entirely supplanted it.

Thus in the perfected organization of the Annelids we would look in vain for a primary longitudinal trunk musculature (perhaps excepting the Hirudinea); but, on the other hand, all the muscles arising from the embryonic mesenchym, as enumerated above, are to be regarded as handed down, with corresponding changes, from the parenchymatous ancestors. In this category belong the transverse muscles, so characteristic of the Annelids, and which are specially well developed in good swimmers. They may have moved from the intraseptal muscle region into the segmental cavity in a horizontal direction to increase the swimming movements, and have thus brought about a subdivision of the cœlom into intestinal and nephridial or lateral chambers.[7]

From the parenchym also arises the retroperitoneal connective tissue, which, though occurring in Annelids in only small quantity, in some cases has a truly parenchymatous character, as cartilage-like supporting tissue. In addition, also, the blood corpuscles [8] in the blood vessels are a remnant of the primitive body-cavity.

The excretory system of the Platyhelminths is commonly regarded as belonging to the parenchym. Scarcely any one doubts that the larval nephridia of the Annelids are homologous to part of that system. I would also derive the definite nephridia, as has been variously done already, from these Turbellarian organs. In this I am guided chiefly by the occurrence of segmentally arranged primary nephridia in many larvæ (two pairs in Polygordius, five pairs in Nereis and Dinophilus), as well as

[7] Since, to all appearances, the so-called protovertebræ of the Vertebrates correspond to the lateral chambers of the Annelids, we would have to refer their ultimate origin to the mode of swimming in the Annelid ancestor, to the formation of these specific, transverse swimming muscles.

[8] Morphologically opposed to these proper blood corpuscles are the lymph corpuscles in the cœlom, which, arising from the peritoneum, form, to a certain extent, secondary leucocytes, and are possibly related to the sexual products, somewhat as the cellular products of the yolk glands in the Platyhelminths.

by the undoubtedly separate origin of the middle excretory portion of the permanent organ (as in Psygmobranchus), which does not come from the peritoneum. It is to be especially emphasized that I would leave entirely out of the question the statements regarding the occurrence of longitudinal canals in Annelids: that concerning Polygordius as not confirmed by any of the subsequent studies, and my own concerning Lanice as being much more likely a secondary than a primitive condition, contrary to my former unpublished opinion. Yet for my part I still believe, in spite of the criticism of this conception by Berg, with its quite unnecessary and unbecoming additions, that the nephridial tubes are to be regarded as parts of a pair of longitudinal canals, such as the Turbellarians have; in which, in consequence of intersegmental constriction of the body, the excreted fluid was checked, and first gave rise to segmentally arranged openings, after which an ultimate division into segmented sections could take place. To the canals, that were primitively closed internally and provided with fine side branches and end cells, were added in Annelids new structures in the shape of peritoneal funnels. Thence the mode of action of the organ gradually, though not radically, changed considerably, and the entire original terminal portion quite disappeared, as being superfluous. Regarding the original signification of the nephridial funnels, we must bear in mind that the segmentation of the primitively uniform pair of sexual glands must give rise to a corresponding number of paired discharging channels for the sexual products. As in Nemerteans, these could appear as centrifugal outgrowths of the follicle wall, and in many cases they may have met the metameric nephridial tubes (instead of reaching the skin directly), have joined to them so that eggs and sperm were discharged from the body, and thus have been transformed into nephridial funnels.[9]

[9] Berg formerly expressed the opinion that the definitive nephridia of Annelids were the canals for the sexual products, and arose originally from the walls of the sexual follicles. In my opinion, this idea is justified only in the above restricted form,—only in reference to the nephridial funnels. Moreover, Berg in accepting Kleinenberg's conception of the mesoderm should, consistently, have given up that opinion, since according to Kleinenberg there are no mesodermal somites comparable to the Nemertean gonads. Yet he affirms that he has retained his opinion of the Annelid nephridium unchanged. An explanation seems necessary!

As regards the ectodermal structures, I wish to be as brief as possible here, and to postpone their more particular consideration to my more detailed publication.

In my opinion, the permanent nervous system of the Annelids is undoubtedly to be derived quite directly from the condition found in the Turbellarians. We are to assume here that in the parenchymatous ancestor, probably, the fusion of ganglia around sense organs to make up the chief centers (as shown in the ontogeny of Annelids) had already been completed. I regard the entire larval system, including the ring nerve of the ciliated band and its ganglia, as a special modification of a still older, originally diffuse, subcutaneous nerve-cell plexus. In accordance with this, the ciliated band would not at all have the significance which has been often ascribed to it, but, like the larval form itself, would be only a secondarily acquired peculiarity of an embryo forced into a pelagic life.

The setæ are characteristic of the Annelids; but even in the Turbellaria similar, though quite superficial, skin formations occur, as for example in the *Enantia spinifera* described by V. Graff. From such dermal armament, at first irregularly distributed, may have arisen the true Chætopodia. And here it is to be noted that in Enantia the cuticular hooks occur laterally upon the entire margin of the body, with the sole exception of the head region, just as the Chætopodia are confined strictly to the trunk of the Annelid.

We may regard the head tentacles and trunk cirri as having arisen as evaginations of specially sensitive regions of the integument; and since vascular loops were drawn into such hollow processes, they became capable of serving at the same time as respiratory organs for the body. The fact that in the trunk the dorsal cirri, or some of them, became true dorsal branchiæ had its origin in that these were least exposed to injury in occasional movements of the worm upon solid substances, and thus admitted of a thining of the integument necessary for respiration. The ventral processes came much more into contact with the substratum, and hence became the bearers of an increased sense of touch.

In the digestive tract it is especially the origin of the pharyngeal apparatus that seems to require explanation; but even here the matter is pretty simple if we regard this as an originally circular evaginable part of the foregut epithelium, provided with radiating muscle cells and covered by circular and longitudinal muscle layers, much as we still find in Annelids. Such a condition may without difficulty be derived from the Turbellarian pharynx. But the armament of teeth and their retraction into special sacs of the pharynx are doubtless acquisitions of a later period in the phylogenetic history of our worm.

But little is to be said concerning the phylogenetic development of the remaining regions of the digestive tract; yet this much is probable, that the Turbellarian-like ancestor of the Annelids had no such branched intestine as the present Planarians, which have acquired it along with the flattening and broadening of the body, but had a simple intestinal tube, as in the Nemerteans, ending posteriorly in an anus.

As a direct corollary from the history of the Annelid body, given here in its general outlines, there results a very definite conception of the morphological signification of the mesoderm, as I have already stated in my above-mentioned communication.

Thus, if in Annelids the peritoneal sacs, with all their derivatives, as well as the segmental cavities in them, are to be derived from the sexual glands of their ancestors, then their stages of development in ontogeny, the mesoderm somites and mesoderm-bands, and finally, to be consistent, also in general the secondary or cœlomic mesoderm of all Metazoa which have it, must have the original signification of a sexual tissue or of gonads.[10]

[10] One of the best evidences would be furnished by a case in which the secondary mesoderm was entirely devoted to the formation of the sexual glands of the adult animal. Such a case seems actually presented, according to the account of S. F. Harmer, in the male of *Dinophilus tæniatus*, a new species of these creatures resembling Annelid larvæ. Here two solid cell-bands in the primary body-cavity, comparable to the mesoderm-bands, are transformed into the anteriorly bifurcated testes, the large cavity of which the author quite justly regards as homologous with the secondary body-cavity of Annelids. On the other hand, the statement of Kleinenberg that the sexual glands in Lopadorhynchus arise directly from the ectoderm by invagination, would furnish very strong evidence on the other side; yet I have convinced myself by my own observations upon the same animal that there is an error here, and that the organs mentioned are formed as usual from the peritoneum.

Yet how can structures have the same phylogenetic origin when they, to all appearances, arise now from the ectoderm, now from the entoderm? The ingenious idea of Kleinenberg, that "the sexual cells do not come from the germ layers," will help us out of this difficulty when properly applied. He says further "that they already existed in the ancestors of the Cœlenterates when composed of loosely arranged similar cells, not yet differentiated into ectoderm and entoderm." I would here replace "Cœlenterate" by "Metazoa," since I cannot regard these radiate creatures as the ancestors of the Bilateralia, but only as animals in which the structure of the body has undergone this special transformation, owing to a previous sedentary mode of life. This, indeed, may well have been the case in all animals with radiate symmetry.

Such primary germ-cells would then have originally formed the origin of the secondary or cœlomic mesoderm, and hence belong as little to one as to the other of the two primary germ layers, but are merely interpolated for a time amongst the elements of one layer or the other in the beginning of ontogeny in the Metazoa. Only we are, however, not able to distinguish them from their neighboring cells. So that it does not signify if they subsequently move into the primary body-cavity as "pole-cells," or temporarily remaining in their first surroundings, furnish cell masses growing into the blastocœl, or else by multiplying in situ form epithelial surfaces that subsequently become completely separated.[11] Thus, as far as the cœlomic mesoderm is concerned, the discussion as to its ectodermal or entodermal origin becomes quite unnecessary. Since the primary germ-cells probably lay on the boundary between the outer and inner layers, where they obtained both favorable conditions of nutrition and the possibility of discharging their derivatives by the shortest route, they could, later on, get into the ectoderm as easily as into the entoderm.

[11] By a similar method Rabl has recently shown how the cœlomic diverticula of the archenteron may be referred to the germ-bands that arise from pole-cells. Whether his "numerical law" is applicable or not, he has thus given a valuable explanation of the apparently different modes of development of such structures; but he is in error when he thinks he can show that the mesoderm universally takes its origin from the entoderm.

We still have the consideration of the question as to the original significance of the embryonic mesenchym. Here again, as it seems to me, the development of the Annelids will help us into the right track,—especially that method of formation of the primary mesoderm which is found in Lopadorhynchus and many other Annelids. The paired rudiment on both sides of the anus in the ectoderm represents, according to Kleinenberg, the chief neuro-muscle origin for the ventral band and the permanent mesodermal structures, but contains, as I think, two different, though closely compressed, formative centres,—that of the permanent trunk nervous system, and that of the secondary mesoderm. There are here, in addition, a series of regions in the ectoderm (considered as "neuro-muscle Anlagen" by Kleinenberg) that, in my opinion, furnish the mesenchym, represented in this special case, to be sure, only by mesenchym muscles. In investigating Lopadorhynchus larvæ I found, however, more of such mesenchym "anlagen" than my predecessor, and as a rule lying in the regions where the elements arising from them subsequently are attached as muscles to the ectoderm.

This discovery, and the circumstance that in other forms there arise from the mesenchym, in addition to the muscles, connective tissue, the larval and parts of the definitive excretory organs, as well as the migrating cells of the primary body-cavity (primary leucocytes), and probably also the true blood corpuscles, that such migratory cells (as in the Echinoderms) may be formed also from the entoderm, suggests the conclusion that morphologically the embryonic mesenchym is not a uniform structure, but represents rather the sum of the undifferentiated "Anlagen" of very various organs and tissues, which originally arose quite independently from the ectoderm or entoderm, and wherever necessary.

It is not as easy to explain the origin of mesenchym structures by the migration in many cases of cells from the embryonic cœlomic epithelium. In such cases we might assume that the various constituents of the mesoderm had united in a common origin. Then in cases where the entire mesoderm is formed by evagination, or through outgrowths of one or both germ layers, the mesenchymatous and cœlomic embryonic elements may be

simply mixed with one another. But where its rudiment is represented by a single pair of pole-cells these must be regarded as blastomeres precociously removed into the blastocœl, and containing in themselves the future sources of the primary and secondary mesoderm, still unseparated. Since the mesenchym has here and there its own pole-cells,—for we must regard as such the nephroblasts of Whitman and Wilson, and the lateral teloblasts of some Hirudinea and Oligochæta according to the later observations of Berg upon the Lumbricidæ,—those mesoderm pole-cells that later give rise to both primary and secondary mesoderm may have been at one time blastomeres, which by division gave rise to the pole-cells of the cœlomic mesoderm, as well as to mesenchym pole-cells, but which later no longer divided.

The above very sketchy presentation of my views of the mesoderm may be summed up as follows: As in Kleinenberg's theory, the entire mesoderm is not to be regarded as a uniform structure of equal significance with the two primary germ layers, but as a combination of "Anlagen" of very diverse organs that arose at one time entirely independently of one another. But an important element of it, the so-called secondary cœlomic mesoderm, or the genito-peritoneal embryonic tissue, as I would call it, has, as contrasted with the embryonic mesenchym, the significance of a primitive organ,—namely, of an ancestral sexual or gonad tissue that arose from the primary sexual cells, belonging to neither germ layer, in the oldest many-celled animals.

Warsaw, April, 1890.

RECORD OF AMERICAN ZOOLOGY.

BY J. S. KINGSLEY.

(Continued from Vol. XXIV., page 1047.)

IT is the intention to catalogue here in systematic order all papers relating to the Zoology of North America, including the West Indies, beginning with the year 1889. An asterisk indicates that the paper has not been seen by the recorder. Owing to the method of preparation it is impossible to collect in one issue all the papers relating to any group, but it is hoped that succeeding numbers will correct this. Authors are requested to send copies of their papers to J. S. Kingsley, Lincoln, Nebraska.

VERTEBRATA.

COPE, E. D.—The homologies of the fins of fishes AM. NAT., XXIV., p. 401, 1890.

MINOT, C.-S.—The concrescence theory of the vertebrate embryo. AM. NAT., XXIV., pp. 501, 702, 1890.

AYERS, H.—Contribution to the morphology of the vertebrate head. *Zool. Anz.*, XIII., p. 504, 1890.—Describes sense organs of the Amphioxus, and discusses segmentation of vertebrate head.

BAUR, G.—On the morphology of the vertebrate skull. *Jour. Morph.*, III., p. 467, 1889 [1890].

HERRICK, C. L.—Suggestions upon the significance of the cells of the cerebral cortex. *Microscope*, X., p. 34, 1890.

PORTER, WM. T.—The presence of Ranvier's constrictions in the spinal cord of vertebrates. *Quart. Jour. Micros. Sci.*, XXXI., p. 91, 1890.

MINOT, C.-S.—Evolution of the medullary canal. AM. NAT., XXIII., p. 1019, 1889 [1890].

COPE, E. D.—Synopsis of the families of vertebrates. AM. NAT., XXIII., p. 849.

NAGAKAWA, ISAAC.—The origin of the cerebral cortex and the homologies of the optic lobe layers in the lower vertebrates. *Jour. Morph.*, IV., p. 1, 1 pl., 1890.

MCCLURE, C. F. W.—The segmentation of the primitive vertebrate brain. *Jour. Morph.*, IV., p. 35., pl. iiii., 1890.—*Vide* AM. NAT., XXIV., p. 187.

GIBBES, H.—The crescent cells of Gianuzzi. *Microscope*, p. 65, 1890.

ELASMOBRANCHII.

PLATT, J. B.—The anterior head-cavities of Acanthias. *Zool. Anz.*, XII., p. 239, 1890.—Describes a pair of cavities in front of the premandibular.

EIGENMANN, C. H. AND R.—Notes from the San Diego Biological Laboratory. *West Am. Scientist*, VI., pp. 123, 147, 1889.—Notes on two sharks and on the embryos of five Elasmobranchs.

BEAN, T. H.—Description of a new Cottoid fish from British Columbia. Proc. U. S. Nat. Mus., XII., p. 641, 1890.—*Synchirus* [n.g.] *gillii.*

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BRAKELEY, JOHN H.—Rapid growth of carp due to abundance of food. Bull. U. S. F. C., VII., p. 20, 1889.

SMILEY, C. W.—Loch Leven trout introduced into the United States. Bull. U. S. F. C., VII., p. 28, 1889.

HAMILTON, W. R.—Croaking of the perch. Bull. U. S. F. C., VII., p. 63, 1889.—In *Haploidonotus grunniens* caused by moving grinders.

EARLL, R. E., AND SMITH, H. M.—The American sardine industry in 1886. Bull. U. S. F. C., VII., p. 161, 1889.—History and statistics.

RAVENEL, W. DEC.—Information bearing upon the artificial propagation of mullet. Bull. U. S. F. C., VII., p. 197, 1889.

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**Rev. Sci. Nat. Appl.*, No. 1., p. 12, Jan. 1889. Trans. in Bull. U. S. F. C., VII., p. 215, 1889.

EARLL, R. E.—Notes on certain fishery industries of Eastport, Maine, in 1886. Bull. U. S. F. C., VII., p. 267, 1889.—Herring.

GILL, T. N.—The families of ribbon-fishes. AM. NAT., XXIV., p. 481, 1890.

RYDER, J. A.—The continuity of the primary matrix of the scales and the actinotrichia of Teleosts. AM. NAT., XXIV., p. 489, 1890.

JORDAN, D. S—Catalogue of fishes collected at Port Castries, St. Lucia, by the steamer *Albatross*, November, 1888. Proc. U. S. Nat. Mus., XII., p. 645, 1890.—87 species; revision of Harengula; *Corvula sanctæ-luciæ* new.

GILBERT, C. H.—A preliminary report on the fishes collected by the steamer *Albatross* on the Pacific coast of North America during the year 1889, with descriptions of twelve new genera and ninety-two new species. Proc. U. S. Nat. Mus., XIII., p. 49, 1890. The new genera are Leuroglossus, Calotomus, Radulinus, Bathyagonus, Xenochirus, (preoc.) Gillellus, Cryptotrema, Plectobranchus, Lucioblennus, Aprodon, Lycodapus, Lioglossina.

JORDAN, D. S., AND EVERMANN, B. W.—Description of a new species of fish from Tippecanoe River, Indiana. Proc. U. S. Nat. Mus., XIII., p. 3, 1890.—*Etheostoma tippecanoe.*

BEAN, T. H.—Report on the fishes observed in Great Egg Harbor Bay, New Jersey, during the summer of 1887. Bull. U. S. F. C., VII., p. 129, 1889.—Annotated list of 101 species.

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TEST, F. C.—New phosphorescent organs in Porichthys. Bull. Essex Inst., XXI., p. 43; 1889.

MATHER, FRED.—Report upon the results of salmon planting in the Hudson River. Bull. U. S. F. C., VII., p. 409, 1889.

DRESSLAR, F. B., AND FESLER, B.—A review of the mackerels (Scombrinæ) of America and Europe. Bull. U. S. F. C., VII., p. 429, 1889.—Fifteen species recognized: *Scomber scombrus, S. colias, Auxis thazard, Gymnosarda pelamis, G. alliterata, Albacora alalonga, A. thynnus, Sarda sarda, S. chilensis, Scombero-*

morus concolor, S. maculatus, S. regalis, S. cavalla, Acanthocybium solandri, occurring in North America.

BEAN, T. H.—New fishes collected off the coast of Alaska and the adjacent region southward. Proc. U. S. Nat. Mus., XIII., p. 37, 1890.—Results of *Albatross* collections; 17 new species described; the new genera are Bothrocara, Poroclinus, Dasycottus, Malacocottus.

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EIGENMANN, C. H. AND R. S.—A list of the American species Gobiidæ and Callionymidæ, with notes on the specimens contained in the Museum of Comparative Zoology at Cambridge Massachusetts. Proc. Cal. Acad., II., i., p. 51, 1889.—74 species enumerated; Clevelandia, n. g.

EIGENMANN, C. H. and R. S.—Notes from the San Diego Biological Laboratory. *West Amer. Scientist*, VI., pp. 124, 147, 1889.—List of 49 Teleosts from Cortez Banks; the new forms are: *Myctophum californiense, M. townsendi, Notoscopelus brachycheir, Ditrema orthonotus, Sebastichthys levis, Icelinus australis, Paricelinus* [n.g.] *hopliticus.* Follows with additions to fauna of San Diego; description of *Phoxinus clevelandi* from Napa County, California, and list of fishes of Allen Springs.

GILL, T. N.—The Halosauroid fishes typical of a special order. AM. NAT., XXIII., p. 1015, 1889 [1890].

——The Notacanthid fishes as representatives of a peculiar order; *l. c.*, p. 1016.

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——The development of *Micrometrus aggregatus*, one of the viviparous surf-perches. AM. NAT., XXIII., p. 923, 1889 [1890].

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HAY, O. P.—The skeletal anatomy of Amphiuma during its earlier stages. *Jour. Morph.*, IV., p. 11, pl. ii., 1890.—Extension of paper in AM. NAT., XXII., p. 315, 1888.

GARMAN, S. W.—Reptiles and Batrachians from the Caymans and from the Bahamas. Bull. Essex Inst., XX., p. 101, 1889 —*Vide* AM. NAT., XXIII., p. 918.

REPTILIA.

BAUR, G.—The genera of the Podocnemididæ. AM. NAT., XXIV., p. 482, 1890.

——Note on the genera Hydraspis and Rhinemys. AM. NAT., XXIV., p. 484, 1890.

——The genera of the Cheloniidæ. AM. NAT., XXIV., p. 486, 1890.

——On the classification of the Testudinata. AM. NAT., XXIV., p. 530, 1890.

ALDRICH, C. A.—Snakes in high places. AM. NAT., XXIV., p. 782, 1890.

COPE, E. D.—Snakes in banana bunches. AM. NAT., XXIV., p. 782, 1890.

STEJNEGER, L.—Annotated list of Reptiles and Batrachians collected by Dr. C. Hart Merriam and Vernon Bailey on the San Francisco mountain plateau and the desert of the Little Colorado, Arizona, with descriptions of new species. *North American Fauna*, No. 3, p. 103, 1890.—19 species enumerated, of which *Crotaphytus baileyi* is new; in foot-notes *Crotaphytus silus* (Cal., Wash.), *Uta palmeri* (Gulf of Cal.), *Uta laevis* (N. Mex.), are described.

BOULENGER, G. A.—First report on additions to the lizard collection in the British Museum. Proc. Zool. Socy. London, 1890, p. 77.—New species from America is *Anolis panamensis.*

SHUFELDT, R. W.—Contributions to the study of *Heloderma suspectum.* Proc. Zool. Socy. London, 1890, p. 148.—Extended study of its anatomy.

STEJNEGER, L.—Description of a new lizard from Lower California. Proc. U. S. Nat. Mus., XII., p. 643, 1890.—*Cnemidophorus labialis.*

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*CORY, C. B.—The birds of the West Indies, including all species known to occur in the Bahama Islands, the Greater Antilles, the Caymans, and the Lesser Antilles, excepting the islands of Tobago and Trinidad. Boston, 1889, 324 pp., 2 maps.

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* ——Osteology of *Circus hudsonius; l. c.*, 1889.

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BOND, F.—Notes from Wyoming. *Auk*, VI., p. 341, 1889.

BREWSTER, W.—Nesting habits of the parakeet (*Conurus carolinensis*). *Auk*, VI., p. 336, 1889.

——*Dendroica coronata* feeding upon oranges. *Auk*, VI., p. 279, 1889.

——The present status of the wild pigeon (*Ectopistes migratorius*) as a bird of the United States, with some notes on its habits. *Auk*, VI., p. 337, 1889.

——*Melanerpes carolinus* eating oranges. *Auk*, VI., p. 337, 1889.

BENDIRE, C. E.—Description of the nest and eggs of *Megascops asio maxwelliæ*, the Rocky Mountain screech owl. *Auk*, VI., p. 298, 1889.

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Greenland, from the MS. of A. Hagerup. *Auk*, VI., p. 211, 1889.

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CHAPMAN, F. M.—Notes on birds observed in the vicinity of Englewood, N. J. *Auk*, VI., p. 302, 1889.

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RICHMOND, C. W.—The yellow-throated warbler (*Dendroica dominica*) near Washington. *Auk*, VI., p. 339.

RAGSDALE, G. H.—On the hiatus existing between the breeding

ranges of the loggerhead and white-rumped shrikes. *Auk*, VI., p. 224.

REED, J. H.—*Troglodytes aëdon* (house wren) building in a hornet's nest. *Auk*, VI., p. 339.

SCOTT, W. E. D.—A summary of observations on the birds of the Gulf coast of Flordia. *Auk*, VI., p. 245, 318.—Cont. of article (*vide* AM. NAT., XXIV., p. 544).

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SCOTT, W. E. D.—On the specific identity of *Buteo brachyurus* and *Buteo fuliginosus*, with additional records of their occurrence in Florida. *Auk*, VI., p. 243.

——A second specimen of Cory's bittern (*Botaurus neoxenus*). *Auk*, VI., p. 317.

SAGE, J. H.—The interbreeding of *Helminthophila pinus* and *H. chrysoptera*. *Auk*, VI., p. 279.

SENNETT, G. B.—*Micropallas whitneyi* (elf owl) taken in Texas. *Auk*, VI., p. 276.

——A new species of duck from Texas. *Auk*, VI., p. 263.—*Anas maculosa*.

TORREY, B.—The killdeer plover wintering on the New England coast. *Auk*, VI., p. 274.

THORNE, P. M.—*Phalaropus lobatus* and *Phalaropus tricolor*. *Auk*, VI., p. 366.

WASHBURN, F. L.—Recent capture of Kirtland's warbler in Michigan, and other notes. *Auk*, VI., p. 279.

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leucoparia (Tex.), *S. saxatilis* (Utah), *S. phenax* (Cal.), *S. latifrons* (Ore.), are new.

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——Description of a new Evotomys from Colorado; *l. c.*, p. 23.—*E. galei.*

——Descriptions of two new species of Evotomys from the Pacific coast of the United States; *l. c.*, p. 25.—*E. occidentalis* (Wash.), *E. californicus* (Cal.).

——Description of a new marten (*Mustela caurina*) from the northwest coast regions of the United States; *l. c.*, p. 27.

——Description of a new species of Molossus from California (*Molossus californicus*); *l. c.*, p. 31.

——Description of a new prairie dog from Wyoming; *l. c.*, p. 33.—*Cynomys leucurus.*

——Descriptions of three new ground squirrels of the *Spermophilus spilosoma* group; *l. c.*, p. 37.—*S. cancocens* (Ariz.), *S. macrospilotus* (Ariz.), *S. major* (New Mexico).

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EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

WE congratulate our readers and other countrymen that the United States Government has at length partially removed a tax on intelligence which has been our opprobrium for many years. We refer to the duty imposed on books imported or received in exchange by private students and investigators from foreign countries. A committee to obtain this reduction was appointed by the American Association for the Advancement of Science at its New York meeting, which now consists of Profs. J. R. Eastman, Washington, S. A. Forbes, Champaign, Ill., and E. D. Cope, Philadelphia (chairman). This committee has not been inactive, and has extended its labors through several administrations. During the preparation of the Morrison tariff bill endeavors were used, which were not successful, to have scientific

books placed on the free list, Mr. Morrison himself opposing the proposition. Efforts were employed to have Senator Allison to incorporate it in the Senate bill prepared by his committee; but like the Morrison bill, this one failed to become a law. The Committee of Ways and Means of the present House, of which Mr. McKinley is chairman, were interviewed several times, and the desired provision was inserted in their bill, which is now the law of the land, having passed both House and Senate and received the signature of the President.

It was thought best by the committee of the American Association to confine its efforts to the free importation of books, and to postpone for the present the question of the free importation of scientific apparatus. The endeavor to have all scientific books placed on the free list was not successful, since a duty of twenty-five per cent. is still levied on books printed in the English language. The committee asked that books issued by the English Government, or by English scientific societies, be placed on the free list, but this was refused. It is to be hoped that this proposition will meet with more favorable consideration at the hands of the next Congress, which is not likely to favor high protective measures.

Our fellow-students have, we hope, already in many instances experienced the benefit of this change in the law, and we shall hope for still greater facilities in future, such as the nature of the case, as well as our reputation as a people, renders absolutely necessary.

—A CIRCULAR has been issued asking naturalists interested in organic morphology to meet in Boston, on December 29th, to form an Association of Morphologists, in connection with the American Society of Naturalists. Morphology is, of course, the *raison d'etre* of scientific anatomy, and a society of morphologists has a comprehensive field, which will include anatomists and naturalists of all kinds. We are heartily in favor of the existence of such a society, to correspond to the Physiological Society, etc., and to meet at the time of the American Society of Naturalists, the Geological Society, and so to form a winter American Scientific Association of experts. At present, however, we have an

Anatomical Society; and the Morphological Society, of course, conflicts with it. The two must be combined if both are to succeed, and how this is to be successfully done is the problem before us. The name "Morphological" has our preference, and we hope that it will be retained; but the membership and organization of the Anatomical Society need not be abandoned.

It is rather unfortunate that the meeting of the American Geological Society has again failed to coincide with that of the societies above mentioned. We hope that the secretaries of the respective societies will be able in future to coöperate, so that the plan of a general winter meeting of American naturalists of all kinds will not be lost sight of.

—THE Association of American Agricultural Colleges and Experiment Stations has at its last two meetings amended its plan of organization in a most important manner. Originally this association was a delegate convention, consisting mainly of college presidents and station directors, who met to discuss the executive affairs of their institutions. But as the station workers increased in members and experience it became evident that there was need for the various specialists also to meet, talk over their work, and arrange plans for coöperation. The horticulturists were the first to take decisive steps, holding a meeting about three years ago. The entomologists and botanists soon followed their example by organizing independent associations. Hence it came to pass that either the scope of the original association of colleges and stations must be enlarged, or else a number of independent organizations would have to exist. Accordingly, at the Washington meeting, one year ago, the general association appointed committees on agriculture, botany, chemistry, entomology, and horticulture; and at the meeting held November 11–14, 1890, at Champaign, Illinois, these committees were changed to sections. Consequently the association now embraces all college and station investigators, and its future meetings will doubtless be second only to those of the American Association for the Advancement of Science in scientific importance.—W.

—THE remarkable success attending the recent introduction of the Australian lady beetle—the Cardinal Vedalia—into the orange groves of California to destroy the Fluted Scale, has called general attention to this method of checking insect injuries, and in many quarters expectations that are hardly justified by our present knowledge of the biological laws governing the subject have apparently been raised as to the practical possibilities of this phase of economic entomology. While there can be no doubt that the introduction of the Cardinal Vedalia has proven one of the most significant triumphs in the agricultural annals of the decade, it is yet too early to draw general conclusions from its history. In cases of this kind the intricate laws regulating the interactions of organisms and adjustment to environment must be given time to operate before definite conclusions can be reached. No organism can multiply beyond the limits of its food supply. Reports from California indicate that the Cardinal Vedalia, which has so far fed exclusively upon the Fluted Scale, is rapidly reaching this limit, and it is difficult to see how there can fail to be a reaction upon its own members as fast as this limit is reached. Doubtless man can greatly assist in preventing too great a reaction by sending specimens from one locality to another. The development of these two insects—the Fluted Scale and the Cardinal Vedalia—in the orange groves of California will be watched with great interest by the entomological as well as the agricultural public.—W.

—THE numbers of the AMERICAN NATURALIST for 1890 were issued at the following dates: January, Feb. 3d; February, Feb. 28th; March, April 3d; April, April 25th; May, June 4th; June, July 15th; July, August 8th; August, Sept. 3d; September, Oct. 14th; October, Nov. 8th; November, Dec. 6th; December, Jan. 9th, 1891.

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RECENT LITERATURE.

The Trees of Northeastern America.[1]—It is rarely the case that one meets with a more satisfactory book than this designed for the non-technical reader. Too often such books are either too technical and scientific for the class of readers to which they are addressed, or, still more frequently, they are so utterly devoid of all science that they are entirely useless. The book before us more nearly strikes the golden mean between these extremes than any we have seen. Mr. Newhall has admirably succeeded in his attempt to make a book "which in simple fashion will so describe the tree from its foliage and bark and style" that one can recognize it.

The general classification adopted is as follows:

Leaves simple { alternate { edge entire; " toothed; " lobed } ; opposite " " }

Leaves compound { feather-shaped { alternate; opposite } ; hand-shaped, opposite }

This key leads to groups of genera in which the species are clearly-described. Thus in the first group of "trees with simple leaves, alternate and entire," we find descriptions of *Magnolia acuminata, M. glauca, M. tripetala, Asimina triloba, Cercis canadensis, Nyssa sylvatica, Diospyros virginiana, Sassafras officinale.* Then follow those with simple alternate leaves which are toothed on their edges, and so on. Rough outline sketches of the leaves and fruits help the reader to easily identify any tree ordinarily found in the forests. It will be of great value to nurserymen and tree-growers. A good feature of the book is the modern nomenclature which is adopted throughout, while at the same time the old names are given as synonyms.—CHARLES E. BESSEY.

[1] The Trees of Northeastern America. Illustrations from original sketches. By Charles S. Newhall, with an introductory note by Nath. L. Britton, E.M., Ph.D., Columbia College. G. P. Putnam's Sons, New York, 1890. 8 vo., 250 pp.

General Notes.

GEOGRAPHY AND TRAVEL.

Alaska.—Mount St. Elias.—The scientific expedition sent out last spring under the joint auspices of the National Geographic Society and the United States Geological Survey, for the purpose of exploring the region about Mt. St. Elias, Alaska, has returned. Mr. Russell, who organized the expedition and had charge of the work, is now in Washington, and, at the request of the Associated Press, has furnished the following picturesque sketch of the work of his party:

The party consisted of Israel C. Russell, geologist; Mark B. Kerr, topographer, both members of the Geological Survey; E. F. Hosmer, general assistant; and seven camp hands, hired at Seattle, Washington, of whom J. H. Christie was foreman. Owing to uncertain health Mr. Hosmer returned home from the first camp. All arrangements for camping in an unknown country were completed at Seattle early in June, and on the 17th the expedition sailed for Sitka on the steamer *Queen*, one of the excursion boats plying regularly between Puget Sound and Southern Alaska. The voyage to Sitka furnished an opportunity for seeing the fine glaciers of Tanku Inlet and Glacier Bay, thus serving as an introduction to the still more wonderful ice fields about Mount St. Elias. On arriving at Sitka the members of the expedition were transferred at once to the United States steamer *Pinta*, under command of Captain Farenholt, who had previously received instructions from the Secretary of the Navy to take them to Yakutat Bay. The *Pinta* reached the mouth of Yakutat Bay on June 25th. The bay is a broad, deep inlet, extending more than thirty miles inland, and it was the plan of the expedition to begin work near its head on the west shore. The weather being thick, Captain Farenholt did not think it advisable to take the vessel up the bay, and the voyage had to be made by means of boats and canoes in a driving rain storm. The actual base of operations was reached on June 28th, and the study of the geology and geography of the region began at once.

"When the storm passed away," says Mr. Russell, "we found ourselves on a wild shore encumbered by icebergs and at the immediate base of a majestic mountain range, trending southeast and northwest. Along the southern base of the mountains there is a plateau some

thirty miles broad, divided by the waters of Yakutat Bay. Our task was to explore and map the country from the bay to St. Elias, and as far beyond as practicable. Excursions were begun at once to the neighboring mountains and glaciers and up Yakutat Bay as far as the floating ice would allow a canoe to travel. One of these excursions took us to an island at the head of the bay, which we named Grandview Island. From its summit, which rises boldly a thousand feet above the water, a magnificent view was obtained of a vast stretch of snow-clad mountains from which glaciers of great magnitude descended to the sea and ended in cliffs of ice several hundred feet high. From these the icebergs crowding the bay were derived. One of these glaciers we named after Dalton, the pioneer explorer of the region; another, of larger size, at the head of the bay, was named in honor of Gardner Hubbard, the President of the National Geographic Society. A magnificent mountain peak, rising some 10,000 feet immediately above the Hubbard glacier, received the same name. Another towering peak on the same mountain crest, triangular in shape and always of purest white, was named Mount Seattle in acknowledgment of the faithful services of our camp hands, whose homes are mostly in the 'Queen City of the Sound.'

"While glacial and geological studies were being pushed forward, Mr. Kerr measured a base line with considerable accuracy, and began a map of the region. From the ends of the base line sights were taken to several peaks and hill tops near at hand, the angles between the lines of sight and the base line affording data for determining other distances. By means of angles of elevation their heights could also be calculated. The stations whose position and elevation had thus been determined were made the extremities of new base lines from which sights to all the mountains in the region could be made, and the heights of the highest peaks accurately determined. In addition to the 'dip angles,' the heights of the stations occupied were determined by means of a mercurial barometer. To aid in this work, a 'base barometer' was read three times a day during July and August by Rev. Carl J. Hendrickson, who has charge of a mission at Yakutat. From this beginning the work of mapping the country was carried forward until all the peaks to be seen from our line of march were located and their heights determined. Sketches and photographs were taken from many points of view. These, together with the triangulation, will furnish material for an accurate map of the region visited. The map will embrace upwards of a thousand square miles.

"As soon as topographic work was well under way a line of march towards St. Elias was decided upon. All of our rations, bedding, tents, etc., had to be carried or 'packed' by the men, the character of the country not allowing the use of animals. At first the trips from camp to camp had to be repeated several times. Profiting by experience we abandoned everything that was not essential, and as our work progressed we found that many things deemed indispensable at first could be left behind. Our line of march was toward the northwest, with the triangular summit of St. Elias as our guide. Fortune favored us in many ways. We found passes in the mountains leading in the direction we wished to travel, and no insurmountable difficulties in the way, although great patience and judgment were required in treading the net-work of crevasses in the ice fields. Probably more than nine-tenths of the journey was across glaciers and snow fields.

"On the first of August we were midway between Yakutat Bay and St. Elias, but still at the base of the mountains. Our camp was in the last and highest grove of trees that it was practicable to reach. The timber line is there about 1500 feet high, and all trees disappear a few miles to the west. An island of rock surrounded by vast glaciers, but clothed with beautiful flowers, rank ferns, and dense spruce trees, furnished a delightful spot for our base camp. We named this lovely oasis in the desert of ice 'Blossom Island.' From there our work in the high mountains began. On following up Marvin Glacier, which flows to the west of Blossom Island for about fifteen miles, we reached an elevation of 4000 feet, and found an easy pass, although filled with glacial ice, leading westward across what from a distance seemed an impassable mountain range. We named this 'Pinnacle Pass' on account of the tapering spires overlooking it. West of Pinnacle Pass we descended to a glacier that has its source to the north of Mount Cook, and separates the mountain range from the St. Elias range. On crossing this glacier and approaching the mountain wall which rises to the west of it, we again found a pass leading toward St. Elias that afforded an easy path to the Conrad glacier, one branch of which rises on the northern slope of the great mountain. Following up this branch we at last, after twenty days' hard work above snow line, found ourselves encamped at the base of St. Elias. The weather had been clear for ten days and we had every prospect of a good day's climb on the morrow. Rising at three in the morning we began what we believed to be the final ascent, but, after a few hours, storm clouds settled down around us, snow began to fall and all landmarks were lost to view. The snow continued for thirty hours without cessation, and it

was with difficulty that we found our way through the blinding snow to a lower camp, where the necessary rations were to be had. A second attempt was made to reach the summit two days later, but another snow storm broke over the mountain as suddenly as the first. This time I was alone in the highest camp, where I was imprisoned for six days before being able to rejoin my party below, while Mr. Kerr was similarly isolated at the first camp lower down. When I started down there was six feet of new snow, which refused to harden, and rendered it impossible to do more work among the high peaks.

"On descending to a lower level I started on an excursion up the glacier between the St. Elias range and Mount Cook, which gave promise of leading to a low path across the main range, but a third snow storm coming on, I was obliged to return to Blossom Island and there rejoined Mr. Kerr, who had descended a few days previous. My stay above the snow line lasted thirty-five days. During that time we lived in tents, many times camping on the open glacier, so as to be out of the reach of avalanches. All of our cooking was done by means of small coal oil stoves.

"After returning to Blossom Island an excursion was made far out on the great Piedmont glacier, which forms a plateau about 1500 feet high, stretching along the southern base of St. Elias range. This glacier is of continental type and has an area estimated at about 1000 square miles. It is the largest glacier known in the Northern Hemisphere, with the exception of the ice fields of Greenland.

"We returned to Yakutat Bay about the 20th of September, having had stormy weather almost all the time since leaving the vicinity of St. Elias. On the 22d of September our hearts were gladdened by seeing the *Corwin* steaming up the bay. Captain C. L. Cooper, commander of the *Corwin*, acting on his own judgment and knowing that we would have a hard time if left at Yakutat until winter set in, made the cruise from Sitka especially for our relief, and conveyed the expedition to Port Townsend, where we arrived on October 2.

"From the point of view of the scientist, if not of the Alpinist, our expedition was a success. The plan proposed before starting was carried out almost to the letter, so far as the study of glaciers, geology, and topography was concerned, but we did not reach the top of Mount St. Elias. The measurements made have determined that all the mountains in this region are lower than was previously supposed, and that St. Elias, instead of being the highest point in North America, is in reality a second-rate mountain. Its elevation, instead of being 19,500 as previously considered, is about 13,500. Mount Cook has

an elevation of 10,250, and Vancouver 8,500. Many other peaks in the same region are as elevated as Cook and Vancouver, but St. Elias is higher than any of its immediate neighbors.

"The more important glaciers and mountains in the region explored were named principally in remembrance of distinguished American geologists who are no longer living. One grand mountain, some thirty miles northeast of Elias, and probably only second to it in height, was named in honor of Sir William Logan, formerly Director of the Geological Survey of Canada. Several lofty spires to the east of Mount Logan were named after the vessels of the navy and the revenue marine that have become celebrated for their voyages in Behring Sea and the Arctic Ocean."

The results of the expedition will be presented to the National Geographic Society some time in November, and as soon after as practicable will be published by the Society in the "National Geographic Magazine."—*Philadelphia Ledger.*

GEOLOGY AND PALEONTOLOGY.

The Transitional Drift of a Portion of Northern Iowa.—In a paper by the present writer on "The Glacial Drift and Loess of a Portion of the Northern Central Basin of Iowa,"[1] which appeared in the NATURALIST a few months since, there was included in the "Upland Drift" an upper silt-like member.

This member was not at that time recognized as a distinct formation, but upon more recent investigations and study is now apparently demonstrated to be. A description of this, we believe heretofore unrecognized, division constitutes the basis of the present paper.

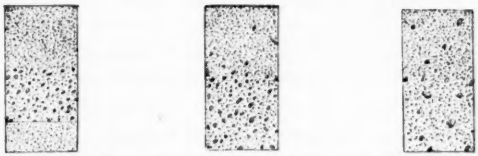
The area here under consideration includes that portion of Northern Iowa lying east of the double moraine, which enters the State from the north; and west of the Loess belt, which borders the Mississippi on the east. This formation is developed over broad areas of surface; and where best developed and most easily defined the contour of the surface is usually of a subdued undulatory type.

[1] In this paper no allusion was intentionally made (except such as became necessary in speaking of the Valley Drift) to the deposits of the glacial epoch, during which the double moraines were formed. In this paper we considered as subdivisions of the "later glacial epoch" both the Loess and Valley Drift. These two formations are, however now shown to represent a subsequent period. The Valley Drift was derived mostly from the materials composing the double moraines, and the Loess appears to mark the highest stage of water during the occupation of the first moraine.

It also sometimes occupies the surface of broad, shallow valleys which are in part filled with Valley Drift.[2] When this occurs, however, it is shown to have been laid down at a period subsequent to that of the upland.

This sheet, as seen developed in the region under consideration, is, for the greater part, of a quite homogeneous silt-like composition, of a grayish-black color, and attains an average thickness of from one to two feet. In places this formation contains well-rounded, smooth, and sometimes striated pebbles of Drift origin, and well-rounded, sometimes angular bowlderettes. At other times neither pebbles nor bowlderettes enter into this formation as component elements.[3]

The three following cuts will give a good idea of the stratigraphical relation which this formation sustains to the subjacent Drift, as well as give a conception of the relative nature of the lithological character of the two divisions.



FIGS. 1–3.—Sections of Transitional Drift and Common Drift, illustrating the relative position and lithological character of the two formations.

1. Section in road cut, in gently undulating prairie region, six miles west of Charles City. The upper bed, which is two feet in thickness, represents the Transitional Drift, and is of a fine homogeneous composition, containing, so far as observed, neither pebbles nor bowlderettes. This passes quite abruptly into the underlying gravelly Drift, which is one and one-half feet in thickness. The lower bed (nine inches thick) is fine siliceous sand.

2. Section in road cut, about two miles north from Rockford, and three-fourths of a mile distant and more than one hundred feet (estimated) above the Shellrock River. The higher bed, a little more than two feet in thickness, is Transitional Drift, the lower part of which is slightly yellow, and contains some rounded pebbles. This passes quite rapidly into the coarse Drift gravel below.

3. A general section of the two sheets under consideration. The upper deposit contains some pebbles and bowlderettes, and passes, more or less rapidly, into the underlying Drift or Till. This member

[2] This is well illustrated in Fig. 2 of the above-mentioned paper.

[3] We have observed this sheet well developed in portions of Southeastern Iowa.

appears to be an intermediate or transitional formation (hence the name Transitional Drift which I have applied) between the true Drift below and the Loess, which occupies a chronological horizon above.

If I discern correctly, the Transitional Drift is distinguishable from true Drift (1) by the almost entire absence of clay; (2) the relatively small amount of gravel and bowlders; (3) by the looseness and more homogeneous nature of its earthy base; and (4) by its stratigraphical position and color. It is also distinguished from Loess mainly by its looseness, color, almost absence of clay, and less homogeneous character, as well as by its containing both gravel and bowlderettes.[4]

It is not infrequently the case that the constituent elements composing the true Drift and the Transitional Drift pass into one another with such gradual and imperceptible gradation as to make it impossible to designate just where the division line separating the two formations should be drawn. At other times, however, the line of demarkation or separation between the two sheets is abrupt and sharply defined.

The material of the Transitional Drift is also sometimes seen to so imperceptibly graduate into the Loess as to make it a hopeless task to undertake to indicate just where the line separating the two deposits should be placed.

It is believed that the component elements of this formation were derived mainly from the less coarse material contained within the glacial ice, which material, upon the melting of the ice, was distributed, with more or less uniformity, by its waters over large areas covered by the Drift, which had accumulated under the glacier.

It is manifest, upon consideration, that the finer material held in suspension by the glacial waters would not settle down so soon as the coarser material forming the Transitional Drift, but would be borne along by the more or less rapidly-moving floods, and finally be deposited in the form of sediment as the waters collected and formed into lake-like expansions along the axis of drainage.

This sediment we conceive to be our typical Loess, which we believe to be analogous to the Transitional Drift, only modified by

[4] Prof. Torrell has distinguished a Drift sheet, apparently somewhat similar to this, in the hilly regions of Eastern America (it is also recognized in Sweden), which has been designated "Upper Till."

"It is held to be distinguished from true Till (1) by its looseness; (2) by the usually large size and angular form of its rock fragments; (3) by the more sandy and porous character of the earthy base; and (4) by the higher oxidation of its iron compounds."

"This is regarded as having been the material embraced *within* the glacial ice or borne on its surface, and by its meiting let loosely down upon the true Till formed beneath the ice."—*T. C. Chamberlin, U. S. Geological Report, 1881–'82, p. 297.*

repeated washing processes, until it finally reached its present remarkable extent and purity.

The numerous bowlders observed in the region under consideration are thought to belong the Drift, and also to represent in part the coarser blocks held *within* the glacial ice.—CLEMENT L. WEBSTER, *Charles City, Iowa.*

Synopsis of American Carbonic Calyptræidæ. By Charles R. Keys (Proc. Acad. Nat. Sci. Phila., 1890, pp. 150–181).—This paper is a complete résumé of all that is at present known concerning the American Carbonic shells, hitherto commonly referred to Conrad's genus Platyceras. There are also incorporated many new observations derived from an exhaustive study of a large amount of excellent material collected during the past few years, besides an examination of nearly all the types of the different forms. Of a single specimen more than three hundred specimens were obtained from a single locality, for the puposes of determining the limits of variation. While it may be regretted that the familiar name established by Conrad nearly half a century ago is given up, it is thought the change will be a great advantage in the consideration of this group, since it has long been regarded by paleontologists who are familiar with the recent shells that Conrad's group actually formed a part of Capulus of Montfort. The habits of the group are discussed, and the attachment of the shells to Crinoids, by which their change of form is attained, is illustrated with many examples. It must be borne in mind that the relation of the two forms does not imply that the Gastropod was parasitic in its habits, as has been generally regarded, but that the mollusc, though for the greater part of its life stationary, probably fed on the excrement of the Crinoid. The remarks upon geographic and geologic distribution have a wide application. The relations of the forms from the Burlington and Keokuk rocks are very significant in its bearing upon the true connection of the two formations. All known forms and new ones are fully described, and a plate of twenty-three figures will aid the student in his study of this interesting family.—H. G. GRIFFITH, M.D., *Burlington, Iowa.*

An Extensive Deposit of Phosphorite Rock in Florida.—Prof. E. T. Cox has recently investigated a deposit of this character which extends from Middle to Northern Florida in beds of probably upper Eocene or Vicksburg age, as determined by Prof. Eugene Smith and others. Professor Cox states that "while the Florida phosphate, like apatite, is almost a pure phosphate of lime, yet it differs so widely

from that mineral in its physical characteristics that I have taken the liberty to give it the name of 'Floridite.' It occurs as a rock that had long been mistaken as a limestone, but unlike a bedded limestone it is mostly in segregated masses, some of which will weigh a ton or more. On the Eagle Phosphate Company's property, of which I made a special examination, a shaft was commenced on an outcrop and sunk to the depth of 41½ feet before it reached the bottom of the solid 'Floridite.' In a paper which I read at the Indianapolis meeting of the A. A. A. S. I gave it as my opinion that the Florida phosphate is a mineralization of an ancient guano. It differs entirely from the coprolite and gravel phosphates of the Carolinas, and the Peace River phosphate gravel or conglomerate phosphates that are found in the bed and shores of Peace River, in the southern part of Florida. The 'Floridite,' or rock phosphate, follows the trend of the Gulf of Mexico, and I have traced it from the southern part of Citrus county as far north as Madison in Madison county, and over a width of country fully twenty miles wide. I do not mean to say that it forms a continuous bed over this area, for there are many breaks where small patches only exist. The rock is found in many places cropping out, but is usually covered with from one to ten feet of sand. It is quarried by stripping off the covering of sand and breaking down the phosphate after the manner of quarrying stone.

"'Floridite' will average 80 per cent. of bone phosphate of lime. It is worth in the European market from $25 to $30 per ton, or, 33 to 38 cents per unit.

"I consider the discovery of this phosphate rock, which has heretofore been taken to be a limestone, as one of great importance to Florida and the entire Union, both on account of its commercial value and its stimulus to profitable agriculture."

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The placing of the diabases among the intrusive rocks has for some time seemed a questionable proceeding to many petrographers. They so often occur as flows between sedimentary strata, and frequently apparently as surface flows, that it would appear more logical to place them among the effusives. Brauns[2] has lately described a diabase from Quotshausen in the valley of the Perf,

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. d. Deutsch. Geol. Ges.* XLI., 1890, p. 491.

a tributary of the upper Lahn, which on its upper surface bears flowage marks like those in modern lavas. A section from this portion of the rock-mass shows a glassy base, dotted with grains of magnetite and mottled with irregularly shaped, doubly refracting areas, without further definite characteristics. Beneath the surface the mottlings resolve themselves into fibrous lath-shaped feldspar crystals, arranged in fluidal lines and extinguishing with a somewhat undulous extinction. The mass between these appears to be homogeneous, but in polarized light it is found to possess aggregate polarization. At a distance of twenty centimetres from its surface the rock consists of well-defined feldspar laths and little grains of augite and altered ilmenite. At 60-100 cm. from this surface it is a typical diabase. The interesting features connected with the occurrence are: 1, the undoubted former existence of the rock magma as a fluid upon the surface, as indicated by the structure of its upper portion and the flowage lines marked by the feldspar crystals; 2, the existence of the typical diabase texture (hypidiomorphic-granular) of the rock at but a little distance beneath its upper surface. The lack of crystals in its upper portion shows that crystallization began only after this part of the magma had come to rest. It was during this period of rest that all the crystallization took place; hence, the author concludes, rest and gradual cooling are the conditions necessary to the assumption of the hypidiomorphic structure. Continuing the subject further, the same writer describes an occurrence of diabase in a flow at Homertshausen, in Nassau. At some distance beneath its upper surface, where crystallization went on gradually, the rock is a normal diabase with an ophitic structure, and possessing no olivine. Nearer the surface it is rich in corroded olivine, poor in augite, and it contains radially divergent feldspar crystals cemented by glass. Nearer to the periphery it is composed of glass, holding crystals of augite and varioles of the composition and structure of diabase (concretions). On the periphery it is a glass with globulites, globosphærites, etc. The minute structure of each of these phases is described in great detail, as is also the effect of the solution of limestone inclusions upon the diabase material surrounding them. In the third[3] division of his paper the author announces that Rosenbusch has decided to place the diabases with the effusive rocks, and then discusses their position in the scheme with respect to other basic effusives. He shows that there is no definiteness in the distinctions between augite-porphyrite, melaphyre, basalt, and diabase. Every definition that is proposed for any one of these rocks breaks down when exam-

[3] Ib., p. 523.

ined critically. He proposes a classification based upon slight differences in structure and appearance, ascribed primarily to differences in the conditions under which the rocks were formed, and consequently upon their geological age. They are divided as follows:

	Paleozoic to Carbon.	Mesozoic to Tert.	Tert. to Recent.
Granular	Diabase	Melaphyre	Basalt
Porphyritic	Diabase-porphyrite	Melaphyre-porphyrite	Basalt-porphyrite
Glassy	Diabase-glass	Melaphyre-glass	Basalt-glass

It is also suggested that further definiteness might be obtained by prefixing the name of the characteristic phenocryst to the second portion of the name of the porphyrites, and to the first part the name of the characteristic mineral not porphyritically developed. Thus olivine-diabase-augite-porphyrite is an olivine diabase containing porphyritic crystals of augite.——Of the two theories proposed for the explanation of the variolite of Durance, the one regards the rock containing the peculiar structure as related in some way to gabbro, the other looks upon it as an endormorphous contact product of diabase Mr. Cole[4] has examined the field relations of the rock, and has come to the conclusion that the variolite is a devitrification product of a spherulitic tachylite occurring occasionally on the sides of diabase dykes, but more frequently on the surfaces of lava flows. According to this view variolite stands in the same relation to the basic lavas as pyromeride does to those of acid character. The author compares the conditions yielding the variolites with those surrounding the Hawaiian lavas. Incidentally he mentions that gabbro is not as abundant a surface rock in the vicinity of Mt. Genévre as has heretofore been supposed. The serpentines of the region he regards as having been derived from some more basic rock than this. The age af the diabases and the associated variolites is supposed to be Postcarboniferous.——Compound spherulites consisting of groups of small spherulites occur in a black obsidian at Hot Springs, in California. The compound body is marked by a divergent structure, which is due to a secondary crystallization set up in the rock after the small spherulites had accumulated at given points to form the compound body. The radiating substance is thought by Mr. Rutley[5] to be orthoclase, crystals of which run uninterruptedly through the smaller spherulites. Mr. Rutley supposes the primitive spherulites to have been formed in the obsidian while it was still

[4] *Quar. Jour. Geol. Soc.*, May, 1890, p. 295.

[5] Ib., Aug., 1890, p. 423.

liquid, and then to have floated around until they aggregated. After the formation of these accumulations they began to crystallize, and this produced the radiating structure. Mr. Iddings, who has also seen the specimens, regards the radiating structure as original and the spherulitic structure as secondary. The bodies, he thinks, are lithophysæ, and not spherulites.——The hornblende-bearing rocks of the Prussian Graftschaft Glantz have been divided into two groups,—the first comprising eruptive syenites, and the second including hornblende schists. Traube[6] believes that the rocks of both groups are but facies of the same mass, but whether eruptive in origin or belonging to the crystalline schist series he is unable to decide. Both the so-called syenites and the hornblende schists consist of orthoclase, quartz, mica, and augite, together with hornblende derived from it. The amount of the hornblende present (all of which is secondary) and of the other constituents varies so widely that intermediate varieties between the two types are quite common. The rock in all cases is an augite-gneiss or a quartz-bearing augite-mica-syenite. From the nature of certain phenomena observed in limestone in contact with the hornblende rocks it is thought possible that these latter are eruptive.——In a very short communication Dr. Hobbs[7] gives an account of the alteration of gabbro into hornblende-gneiss through gabbro-diorite at Ilchester, Md. The change from gabbro into gabbro-diorite is similar in its essentials to that described by Williams in the Baltimore area. The change into gneiss is effected through the granulation of feldspar, the fraying-out of hornblende, and the production of epidote and quartz.——Pilot Knob, a hill seven miles southwest of Austin, Texas, is regarded by Prof. Hill as a Cretaceous volcano. Its material, according to Mr. Kemp,[8] consists of nepheline-basalt, with phenocrysts of olivine and augite in a ground-mass of microlites of augite and grains of magnetite in a nepheline-glass.

Mineralogical News.—*New Minerals.*—Rammelsberg[9] has discovered associated with the eudialyte of Sigterö, near Brevig, in Norway, a new feldspar, which he calls *sigterite*. It has the cleavage of orthoclase. Its extinction against the edge $oP \wedge \infty P\bar{\infty}$ is 16°. On oP two sets of twinning lamellæ make with each other angles of 7°–9°. The extinction of each individual is therefore 3½°–4½°. An analysis, corrected for impurities, gave: SiO_2=50.27; Al_2O_3=

[6] *Neues. Jahrb. f. Min.*, etc., 1890, I., p. 95.

[7] Trans. Wis. Acad. Sci., etc., VIII., p. 155.

[8] *Amer. Geol.*, Nov., 1890, p. 292.

[9] *Neues. Jahrb. f. Min.*, etc., 1890, II., p. 71.

30.75; Na_2O=14.24; K_2O=4.73. This corresponds to $(NaK)_2Al_2Si_3O_{10}$, which according to the Rammelsberg view is $(NaK)_2Al_2(SiO_3)_4+(NaK)_2Al_2(SiO_4)_2$. By doubling the formula it becomes a combination of albite and an alkaline anorthite, with nearly the composition of anhydrous natrolite. The new mineral is, consequently, a very basic alkaline feldspar, related to albite as follows: Albite = $R_2Al_2Si_6O_{16}$; sigterite = $R_2Al_2Si_3O_{10}$.——*Quetedite*, from the Salvador mine in Quetena, Chili, is a reddish-brown, translucent to opaque mineral, with a slightly waxy lustre. Its hardness is 3, and density 2.08–2.14. It occurs[10] massive, associated with copper vitriol, and in prismatic monoclinic or triclinic crystals in the latter mineral. Its analysis gave:

$$SO_3=37.37;\ Fe_2O_3=22.70;\ MgO=5.92;\ H_2O=34.01$$
$$=Fe_2S_2O_9+MgSO_4+13H_2O.$$

——*Gordaite* accompanies sideronatrite from Sierra Gorda, near Caracoles, in Chili, as one of a number of thin coatings covering this mineral.[10] It is glassy, transparent, and forms short, broadly-tabular pieces and crystals, or fibrous masses of a white to light gray color. Its hardness is 2.5–3, and specfic gravity 2.61. The crystals are triclinic prisms with their lateral faces vertically striated. The mineral forms the end member of a series of hydrous iron-sodium sulphates, of which sideronatrite, with but a small proportion of sodium, is the other end member. The composition of gordaite (SO_3=50.85; Fe_2O_3=19.42; Na_2O=22.36; H_2O=7.33) corresponds to $Fe_2S_2O_9+3Na_2SO_4+3H_2O$.——*Tamarugite*, from Tarapaca, Chili, is described by Schultze[11] as a massive, colorless, radiated mineral, with a hardness of 2, and a density of 2.03. In composition it differs from soda alum in its percentage of water, as indicated by the formula $Na_2SO_4+Al_2(SO_4)_3+12H_2O$.——*Ciplite* is a phosilicate of calcium occurring in the chalk of Ciply, in France.[12]

General.—Up to the temperature of 570° *quartz* crystals expand rapidly, both parallel and perpendicular to the vertical axis, and at this temperature become fissured. Above this temperature quartz expands very slightly, in some cases even appearing to contract.[13] Between 560° and 580° sections perpendicular to *c* become doubly refractive. The double refraction increases rapidly below 570°, and above this

[10] Frenzel. *Min. u. Petrog. Mittheil*, 1890, XI., p. 217.

[11] Verh. d. Ver. Santiago, 1889. Ref. *Neues Jahrb. f. Min.*, etc, 1890, I., 258.

[12] Ortlier: Ann. Soc. gèol. du Nord., XVI., 1888–89, p. 270. Ref. Bull. Soc. Franc. d. Min., 1890, XIII., p. 160.

[13] Le Chatelier. Bull. Soc. Franc. d. Min., 1890, p. 112.

temperature remains nearly constant. The birefringence[14] is also subjected to a sudden change at this temperature. Other experiments to be made in this same line will undoubtedly show that 570° is a critical temperature for the mineral, above which it loses its characteristic properties.——Cleavages parallel to R and —R, and less perfect ones parallel to ∞P and oP, have been detected by Mallard[16] in thin plates of quartz. The discovery confirms the suspicion that the mineral possesses obscure cleavages, usually noticeable only when fragments of it are heated and plunged into cold water.——In an article in a recent Bulletin of the U. S. Geological Survey, Mr. Hillebrand[17] gives the results of analyses of some rare zirconium minerals found in the granitic debris of Devil's Head Mountain, Douglas Co., Colo. He also records the analysis of a white *beryl* from the gangue of a cassiterite vein at Winslow, Me. The composition of the beryl is:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	BeO	MgO	$(KCs)_2O$	Na_2O	Li_2O
65.21	tr.	18.50	.33	13.03	.09	.14	.87	.16

H_2O	Sp. Gr.
1.80	2.707

——Although specimens of *tyrolite* recently obtained at the Mammoth Mine, Utah, are sufficiently well crystallized to afford Prof. E. S. Dana[18] data for the determination of the ratio between their lateral axes, it has not been possible to decide upon their chemical composition. The crystals are in flat tables, united into fan-like groups. They are orthorhombic, with their optical axes in the brachypinacoid. Their double refraction is negative and $a:b=.9325:1$. An analysis by Mr. Hillebrand yielded:

CuO	CaO	As_2O_5	H_2O	SO_3	Fe_2O_3	Ins.
45.08	6.78	28.52	17.21	2.23	.08	.16

But this is not capable of representation by a rational formula.——The characteristics of *polycrase* have been defined with some accuracy by Messrs. Hidden and Mackintosh.[19] The material investigated was obtained in the zircon region in Henderson Co., N. C., and from the Upper Salida River, S. C. The mineral occurs in rough crystals bounded by $\infty P\breve{3}$, $P\breve{\infty}$, $2P\breve{\infty}$, $P\breve{3}$, and $\frac{1}{3}P\bar{\infty}$, the latter new to the

[14] Ib., p. 119.

[15] Ib., p. 123.

[16] Ib., p. 61.

[17] Bull. No. 55, pp. 48–55.

[18] *Amer. Jour. Sci.*, Apr., 1890, p. 271.

[19] *Amer. Jour. Sci.*, Apr., 1890, p. 302.

species. It is black on a fresh fracture, and has a brownish-yellow translucency on thin edges. It has a density of 4.925–5.038, a hardness of 5.5, and a light yellowish-brown streak. On exposed surfaces it alters to a lemon-yellow *gummite*, with a density 3.354, and hardness 3.5. An analysis of the crystals from South Carolina gave:

$Cb_2O_5.Ta_2O_5.TiO_2$	Y_2O_3etc.	PbO	FeO	Fe_2O_3	UO_3	CaO	H_2O
47.88	21.23	.46	2.47	.18	19.47	.68	4.46

Ins.	SiO_2	F
.12	1.01	und.

The authors call attention to the fact that the mineral is the first representative of the columbo-titanates in America.——The rare mineral *eukairite* has been found in Villa Argentinia, Prov. Rioja, Argentine, and at several localities in the Andes, associated with calcite, bornite, and other sulphides of copper. It crystallizes in cubic forms (not necessarily regularly), and has a density of 7.641–7.661, and a composition, according to Otto,[20] as follows: Ag = 42.7; Cu = 25.5; Se = 31.5. In general appearance it is like galena.——Lacroix[21] describes the optical properties of quite a numer of *crocidolites*, and concludes that the mineral is a variety of hornblende very widely spread through rocks of various kinds. It may be distinguished from glaucophane by its positive double refraction on basal sections, and its negative refraction in elongated sections.——After analyzing a large suite of *wads* and *psilomelanes*, Gorgeu[22] is inclined to regard them as manganites of various bases, corresponding approximately to the formulas $3(MnO_2)RO + 1\text{-}3H_2O$. Among the wads examined were a few quite well crystallized.——Four crystals of *orthoclase* from the porphyritic granite of the Fichtelgebirg are described by Müller[23] as interpenetration twins, in which each individual is elongated in the direction of its *a* axis. Their oP faces are in the same plane, so that their combination is ×-shaped, with the twinning plane a hemi-pyramid.——Laspeyres[24] suggests that the ground-form of *biotite* be made to correspond with that of clinochlore, so that the isomorphism of the two minerals may be made more apparent.——Messrs. Clarke and Schneider[25] have shown experimentally that the *talc* from Hunter's Mill, Fairfax Co.,

[20] Ber. d. deutsch. chem. Ges., XXIII., 1890, p. 1039.

[21] Bull. Soc. Fran. d. Min., 1890, p. 15.

[22] Ib., p. 21.

[23] *Zeits. f. Kryst.*, XVII., 1890, p. 484.

[24] *Zeits. f. Kryst.*, XVII., p. 541.

[25] Ber. d. deutsch. chem. Gesel., XXIII., p. 1537.

Va., comports itself more like a meta-silicate than like a basic pyro-silicate. They therefore decide against Groth's formula for this mineral, and propose instead the formula $H_2Mg_3(SiO_3)_4$.——Crystals of *sulphur* containing twenty-one forms line clefts in galena at Bassick. Their axial ratio is $a:b:c=.8151:1:1.9066$. Busz,[26] who describes these sulphur crystals, describes also in the same article a *beryl* crystal from St. Piero, Elba, *fluorspar* and *göthite* from Cornwall, *hypersthene* from Monte Doré, and *corundum* from Lake Laach.——*Bucklandite* from the Pfitschthal, Tyrol, and *epidote* crystals from Oberhollersbachthal in Pinzgau, and from Floss in Bavaria, have been examined crystallographically by Brugnatelli.[27]——*Pyrophysalite* occurring in a granite dyke at Finibo in Sweden, *augite* from Risoe in Sweden, and *martite* from an iron mine in Ypanema, Saõ Paulo Province in Brazil, have been briefly described by Kenngott.[28]——The composition of *arsenopyrite*,[29] from Goldkronach and from Neusorg in the Fechtelgebirge is:

	S	As	Sb	Fe	Ni	Co	Ag	Sp. Gr.
Goldk.	20.84	41.36	3.73	34.07			.002	6.09
Neusorg.	17.27	42.89		34.64	4.38	tr.		5.96

——*Chalcocite*[29] from the Kathrina mine near Innsbach, in the Bavarian Pfalz, contains:

Cu	Fe	As	S	Co and Ag	Sp. Gr.
78.44	.93	1.22	20.13	tr.	5.68

——*Minium* from Leadville, thought by Mr. Hawkins[30] to be a pseudomorph after galena, has been examined with the following result:

Pb_3O_4	Fe_2O_3	V_2O_5	Insol.	Sp. Gr.	Hardness.
91.39	.80	.52	7.51	4.57	2.5

——Mr. Seamon[31] thinks that the *calamine* of Missouri was produced by segregation from zinciferous clays formed by the reaction between zinc sulphide and hot silicious waters.——Baumhaur's[32] recent investigations on *apatite* crystals from various localities affirm the statement that the density and axial ratio of this mineral increase with the decrease of chlorine in its composition.——In a short communication

[26] *Zeits. f. Kryst.*, XVII., p. 549.
[27] Ib., XVII., p. 529.
[28] *Neues Jahrb. f. Min.*, etc., 1890, I., p. 87.
[29] Sandberger. Ib., 1890, p. 99.
[30] *Amer. Jour. Sci.*, Jan., 1890, p 42.
[31] Ib., 1890, p. 39.
[32] *Zeits. f. Kryst.*, XVIII., 1890, p 31.

Miers[33] shows that *stephanite* is not hemihedral, but that its crystals are usually twinned hemimorphic forms.——Brief descriptions of *cerussite*, *anglesite*, and *calcite* crystals from the Diepenlinchen Mine, near Stolberg, are given by Dannenberg.[34]——*Phenacite* and *topaz*, the latter altering into *damourite*, occur at Amelia Court House, Va. On the former mineral from Hebron, Me., Mr. Yeates[35] has discovered the basal plane.——Prof. Dana[36] finds that the barium sulphate from Perkin's Mills, Templeton, Can., described by Lacroix as a monoclinic dimorph of barite under the name *michel-levyte*, is really orthorhombic, and therefore true *barite*, and that the peculiar striations observed on it are probably due to pressure.——Minute crystals of *jarosite* line cavities in a siliceous *limonite* at the Mammoth Mine, Utah.[37]——*Thenardite*, *glauberite*, and *calcium carbonate* pseudomorphs of the last-named mineral form thick deposits in a lake-like depression in the Verde Valley, Ariz. Mr. Blake,[38] to whom we owe this knowledge, mentions also the existence of *bournonite* at the Bogg's Mine, Yavipai (?) Co., in the same State.——Heddle[39] declares that *brinachite* of Wallace,[40] occurring in veins in a conglomerate in Inverneshire, is fluorite.——The same author[41] has made a very superficial examination of two crystals of *gyrolite* from the Freshinish Islands, near Mull, England, and pronounces them probably monoclinic.——Solly records his measurements of *struvite* crystals formed by micro-organisms in gelatine culture tubes.

Miscellaneous.—Messrs. Gattermann and Ritschke,[42] in their work on Azoxyphenolether, have obtained a substance which they call anisolazoxyphenetol. This substance, though liquid, appears to possess many of the characteristics of crystals. Its drops are doubly refractive and dichroic.——In a very interesting communication Rinne[43] shows that the oxides of the metals are isomorphous with their corresponding sulphides, a view that is in perfect harmony with the chemical relations existing between oxygen and sulphur. The minerals thus thought to be isomorphous are zincite and wurtzite, valentinite and

[33] Ib., XVIII., p. 68.
[34] Ib., XVIII., p. 64.
[35] *Amer. Jour. Sci.*, Apr., 1890, p. 325.
[36] *Amer. Jour. Sci.*, Jan., 1890, p. 61.
[37] Genth. Ib., p. 73.
[38] Ib., 1890, p. 43.
[39] *Miner. Mag.*, Oct. 1889, p. 272.
[40] Ib., 1887, p. 42.
[41] Ib.,1889, p. 279.
[42] Ber. d. deutsch. chem. Ges., 1890, p. 1738.
[43] *Zeits. d. deutsch. geol. Ges.*, XLII., 1890, p. 62.

stibnite, manufactured bismuth oxide and bismuthinite. The following groups are also thought to be isomorphous, since they occur in isomorphous compounds: CdO and CdS, MnO and MnS, and FeO and FeS.——Mr. Dudley [44] describes pseudomorphs of vivianite after roots of coniferous plants, from the clay banks of the Cumberland River, ten miles above Eddyville, Ky.——In a short note Wulff [45] suggests a method by which plane angles may be measured under the microscope when the apex af the angle cannot be seen, and when its two sides cannot be brought into the field of view at once.——Mr. Brünnel,[46] of the firm of Voight & Hochgesang, has invented a heating apparatus, attachable to any microscope, for use in mineralogical investigations.

New Books, etc.—The ninth annual report of the State Mineralogist of California contains statistics of the mineral products of the State for the year 1889, and accounts of the geology of the mining districts.[47]——The Mineral Resources [48] of the United States for 1888, though late in appearing, is as welcome an addition to mineralogical literature as any of its predecessors have been. The wealth of information within the 630 pages of the present volume defies abstraction. The value of the metallic products of the country for the year in review exceeded the value of those mined in 1887 by about six millions of dollars; while the non-metallic products were larger by seventy-two millions than those of the preceding year. The totals for 1888 are: Metallic products, $256,257,517; non-metallic products, $322,293,159; unspecified, $6,000,000; grand total, $584,550,676. Of especial scientific interest is the description of the occurrence and association of the tin ore of the Black Hills, Dak.——The third part of Hintze's Mineralogy,[49] which has but recently appeared, concludes the tourmaline group of minerals and takes up the humite, helvine, melanocerite, and other groups of rare silicates, as well as dioptase, staurolite, bementite, prehnite, and individual minerals of less common occurrence.

[44] *Am. Jour. Sci.*, Aug., 1890, p. 120.
[45] *Zeits. f. Kryst.*, XVIII., p. 277.
[46] *Neues Jahrb. f. Min.*, etc., 1890, II., p. 87.
[47] Wm. Ireland. Ninth Ann. Rep. of the State Mineralogist for 1889. Cal. State Miner. Bureau, Sacramento, Cal.
[48] D. T. Day. Mineral Resources of the United States for 1888. Washington Govt. Print. Office, 1890.
[49] Leipzig. Veit & Co., 1890, pp. 321–480, 79 Fig.

BOTANY.

An Old Botanical Letter.—In a copy of Persoon's "Synopsis Methodica Fungorum," recently purchased of a London bookseller for the botanical library of the University of Nebraska, the autograph letter given below was found. It was probably addressed to Sowerby, the author of the "English Fungi" alluded to in the first paragraph. The letter is given *verbatim et literatim :*

DEAR FRIEND,

At last I have the pleasure to send You my Synopsis fungorum, You desired to have long ago. I wish You may not be disappointed in Your expectation of it. You'll find many of the species You have published in Your English fungi. I have had the confidence in the justness of Your representations that I have made the descriptions according to them ; if I have been mistaken in this proceeding, I beg You to instruct me of it by a letter.

You have received sometime since several letters and parcels from me, without my having the pleasure to receive an answer from You. I believe therefore to be intitled to give You a gentle reproof for it. However You may make amends for it by writing me soon, particularly if You joined to the letter a good quantity of plants principally cryptogame ones. I remain with esteem and friendship

Sir

Gottingue, May 2, 1801. You mosobedient servant

C. H. PERSOON.

The last sentence is marvelously like those written by botanists to-day. How many of us are wont to forgive our tardy correspondents on the same terms, even to specifying "principally cryptogame ones."—CHARLES E. BESSEY.

The Host-Index of the Fungi of the United States.—Part II. of this exceedingly useful publication has just appeared, extending the index through the Gamopetalæ and Apetalæ. The authors—Professor W. G. Farlow and Mr. A. B. Seymour—state that the remainder of the work will appear in November of the present year. They request that "botanists having errors or omissions to report in the parts already issued would kindly inform them regarding such errors and omissions at an early date, in order that the corrections and additions may be inserted in the forthcoming third part."

For the benefit of those who have not seen this work we may say that it is a systematic list of the Phanerogams which are affected by

fungi. All the fungi known to affect each species are given, making in some cases a long list; as, for example, in the beech (*Fagus ferruginea*), which has 103; the white oak (*Quercus alba*), 90: the buttonwood (*Platanus occidentalis*), 37; the white elm (*Ulmus americana*), 24; the white ash (*Fraxinus americana*), 31; the sassafras (*Sassafras officinale*), 42. It would be an interesting inquiry to investigate the relation between the structure and habits of the hosts and the number of fungi which live upon them. A casual examination appears to show that those species which are most widely distributed are most affected by fungi. Woody plants appear to be somewhat more troubled than are their herbaceous relatives, and there seem to be more upon large plants than upon small ones.—CHARLES E. BESSEY.

Some Bad Station Botany.—The experiment stations have in the main been fortunate in their botanical publications, and very little has gone out from them which is misleading or unscientific. Now and then a worker in one line steps over into that belonging to some one else, and then the results are not so satisfactory. We have before us a good illustration of this in a recent bulletin from the Ohio station, in which the agriculturist discusses "Smut in Wheat," meaning thereby the so-called "stinking smut" of the genus Tilletia. After quoting Professor Henslow as the authority for the remarkable (?) fact that "the spores have been accurately measured, and the diameter found to be one sixteen-hundredth of an inch" (as if any freshman in a botanical laboratory couldn't have measured the Ohio spores!), he quotes some calculations as to the number of spores in a single grain of wheat, and the still more remarkable statement "that it is hardly possible to conjecture how many sporules each spore contains, since they are scarcely distinguishable under very high power of the microscope." This last is about as bad as the usual newspaper science, but we certainly expected something better in an article from a station worker. This is not agricultural science; it is sheer ignorance.—CHARLES E. BESSEY.

Wheat Smut.—In pleasing contrast to the work done in some experiment stations is that by Professor Kellerman and Mr. Swingle, of the botanical department of the Kansas station. A recent bulletin on the fungicides for stinking smut of wheat is a model of good work. It is modestly called a "preliminary" report, but the subject is as well wrought out as in most so-called "final" reports.

After a brief but most excellent statement of the main points in the life-history of the fungus, the details of a number of experiments are given, the object of which was to prevent the smut by treatment of the seed before planting. Fifty-one different treatments were used with

varying results. Of these, three prevented the smut entirely, although injuring the vitality of the wheat to a certain extent. Six other treatments reduced the smut to less than one per cent. The three first mentioned were (1) soaking for twenty-four hours in a five per cent. solution of copper sulphate; (2) soaking for thirty-six hours in Bordeaux mixture (copper sulphate two and two-third lbs., lime five lbs., water four gal.); (3) soaking for twenty hours in a five per cent. solution of potassium bichromate. Of the six treatments which effected a reduction of the smut to less than one per cent., that in which the seed was soaked for fifteen minutes in water at a temperature of 132 degrees Fahrenheit was the simplest, and, all things considered, the best. The investigators give it their approval for general use.—CHARLES E. BESSEY.

A Key to the Mosses.—Professor Charles R. Barnes, of Madison, Wis., has done a good thing for the students of mosses by preparing a handy key to the genera and species found described in Lesquereux and James's "Manual." A somewhat hasty examination of it indicates that it is well calculated to aid the beginner. Copies may be obtained of the author for fifty cents each.

Reserve Food-Materials in Buds and Surrounding Parts.—Professor Halsted's paper on this topic, published in the Memoirs of the Torrey Botanical Club, is a valuable contribution to our knowledge of the nutrition of the shoot in early spring. He takes up in order terminal buds, lateral buds, and twig sections. Naturally the most important reserve material was found to be starch, and its distribution occupies the greater part of the paper. It is found quite generally at a short distance below the growing point. Grape sugar is present in all terminal buds. Other cell-contents are discussed in the paper, and the suggestive fact is recorded that crystals "are especially numerous in the cellular tissue that lies between the leaf scar and the bud above it." They are abundant also "just below the growing tips of all buds."

In the study of twigs several interesting and unexpected things come out, as, for example, the fact that the spines found upon many trees and shrubs are more or less well filled with starch. As to these the author makes the following remark: "It is very likely that the spines are primarily for the warding off of enemies, but if we can look upon the protective organs as serving another purpose, it adds further dignity to the police department, so to speak, of the plant." A couple of pages are given to methods and reagents, and two plates serve to illustrate the histology of the paper.

North American Species of Tylostoma.—Mr. A. P. Morgan, in continuing his papers on the North American Fungi, has made a revision of the species of the genus Tylostoma, one of the stalked puff-balls. He recognizes five species, two of which are new. The species fall under two sections, viz.: (1) Cyclostoma, with circular, entire mouth, containing *T. mammosum* Mich. and *T. verrucosum* Morgan; and (2) Schizostoma, with irregular, lacerate mouth, containing *T. fimbriatum* Fr., *T. campestre* Morgan, and *T. meyenianum* Kl. All the species are illustrated by good figures.

Watson's Contributions to American Botany.—Contribution XVII., issued September 25, consists of miscellaneous notes upon North American plants, and descriptions of new species from Northern Mexico. In the first a synopsis of the known species of Streptanthus is given, twenty-two species being recognized, three of which are described for the first time.

Dr. Watson reviews the question of the synonymy of *Andropogon furcatus* Muhl., and says that Lamarck's species, *A. provincialis*, "was based upon what was said to be a grass of Provence, in Southern France." This was in 1783. Gerard, in 1761 figured and described the same grass. Both Gerard and Lamarck cite synonyms belonging in part to *A. ischæmum*. Both descriptions and figures agree best with the *A. furcatus* of Muhlenberg, which appears to have been grown in some of the gardens of Europe at or before Lamarck's time. "It is highly probable, therefore, that the original *A. provincialis*, aside from its synonymy, and *A. furcatus* are the same species." However, Dr. Watson urges that Muhlenberg's name should be retained; the other, he says, "is a false name, and it cannot be justifiable to make a change for the sake of reviving and perpetuating an error."

A new genus of Rutaceæ (Sargentia) is characterized, and one species (*S. greggii*) described, from material collected by Mr. Pringle in Northern Mexico. Two other new genera are characterized, viz., Rhodosciadium (Umbelliferæ), and Jaliscoa (Compositæ, Eupatoriaceæ).—Charles E. Bessey.

New North American Fungi.—Under this title J. B. Ellis and B. M. Everhart describe a large number of fungi, in the Proceedings of the Academy of Natural Sciences of Philadelphia. Nearly all are Ascomycetes, the genera Valsa, Diatrype, Sphærella, Leptosphæria, Cucurbitaria, Nectria, Plowrightia, and others being represented. Two new species of the last-named genus are described, viz., *P. staphylina*, on Staphylea, from London, Canada, and *P. symphoricarpi*, on *Symphoricarpus occidentalis*, from Montana.

ZOOLOGY.

Fresh-Water Sponges.—Maas[1] has studied the fresh-water sponge in Berlin. He describes the segmentation of the egg and the process of formation of the germ-layers. The latter exhibits some similarity to gastrulation in its broader features, and results in the formation of a closed cavity at one end of the oral germ. From the seemingly similar cells of this germ the ecto- meso- and entoderm are developed. The ectoderm is at first distinctly columnar. The mesoderm cells soon acquire a distinctly mesenchymal shape, and begin the formation of spicules before the appearance of the ampullæ. The entoderm appears to develop from the lining cells of the cavity of the germ, and consists of a flattened epithelium connecting here and there with globular anlage of the ciliated chambers. These latter sink further into the mesoderm, the flattened epithelium becoming drawn out to form efferent canals. The efferent openings are produced by a thinning of the ectoderm and a final breaking through. Maas did not see the process of formation of the osculum. Soon after the differentiation of the germ-layers the embryo (which has previously led a free life) loses its cilia and settles down, at the same time becoming flattened into a thin sheet. Connected with this, the ectoderm loses its columnar character and becomes flattened. Maas gives more proof —if more was needed—that Götte was wrong when he said that Spongilla loses its ectoderm during the process of development.

Notes on Earthworms.—In a paper,[2] devoted chiefly to descriptions of genera and species, Mr. F. E. Beddard prints some interesting points concerning earthworms. *Perichæta indica* is recorded from South America; it was previously known from the East Indies and New Caledonia. Perichæta, from its distribution, from its nephridial system and its circles of chætæ (Lankester's restriction of the term setæ is advisable), is regarded as the more primitive, and the bunches of chætæ in other earthworms are derived from this, rather than from the parapodia of some Polychæta. In the posterior part of the body of *Perichæta indica* are peculiar glands attached to the posterior sides of the septa on either side of the dorsal vessel. Somewhat similar septal glands occur in Acanthodrilus. Chemical tests seem to show the presence of glycogen in these

[1] *Zeit. Wiss. Zool.*, L. Heft 4.

[2] Proc. Zool. Socy. London, 1890, p. 52.

organs,—and this in the epithelial cells, and not in the muscles as Barfurth thought. It also occurs in less quantity in the other peritoneal cells.

Teredos in Telegraph Cables.—At a recent meeting of the Zoological Society of London attention was called to the fact that Teredos caused no little trouble to the managers of submarine cables off the Brazilian coast. These molluscs penetrate between the sheathing wires when in the embryonic stage, and then bore into the tanned jute, and even scoop out pieces from the gutta-percha sheathing of the conductor. Faults made by these Teredos are very difficult to locate, as they leave no external sign.

Scarcity of Oysters.—Owing to overdredging the oyster supply of the Chesapeake will be very small during the coming winter. The packing houses in Baltimore are finding it difficult to obtain supplies sufficient to keep them going at the rate of last winter. In 1888 and 1889 it was not unusual for the canning houses to steam 50,000 bushels a day, but this year the supply is at least fifty per cent. less. It does not need much of a prophet to point out that if the present overdredging be kept up for a few years longer the supply of Chesapeake oysters will be a thing of the past.

Hermaphroditic Anlage in Insects.—A very interesting and important article on the hermaphroditic anlage of sexual glands in *Phyllodromia* (*Blatta* L.) *germanica* has recently been published by Herr R. Heymons in the *Zoologischer Anzeiger*, August, 1890. The article contains only the most important results of Herr Heymons's investigations, which are to be published later in full. The investigations were carried on in the Berlin Zoological Institute, under the direction of Prof. F. E. Schulze, of Spongia fame.

Herr Heymons undertook to work out as carefully as possible the development of the sexual glands; and in the present incomplete state of our knowledge as to the origin and growth of these glands in insects such extended study with the aid of modern technic is very welcome. The first appearance of the sexual glands is of particular interest. Herr Heymons observed that the sexual cells have their origin chiefly in the walls of the cœlomic sacs. A smaller portion arises from the unsegmented mesoblastic layer, at a period before the primitive segments make their appearance. The author is undoubtedly correct in regarding this origin of the sexual cells from the walls of the body-cavity as an extremely primitive relation. It is interesting to note the correspondence with lower forms. In the Annelids, *e.g.*, the genital

cells are also modified epithelial cells of the body-cavity, and this agreement adds unquestioned weight to the opinion that the insects stand in phylogenetic connection with the Annelids.

The genital anlage takes its origin from these genital cells together with certain smaller ones,—the "epethelial" cells of the entomologists. It is elongated and paired in both sexes, and lies either side of the intestine; the numerous egg-tubes which comprise the ovary of the female arise from these two cell-strands. With regard to the parts composing the ovarian tubes Herr Heymons does not agree with former authors. He states that the epithelial are of an entirely different origin from the eggs, whereas they were hitherto held to be of like origin,—at first an undifferentiated mass of cells, which afterwards gradually separate into egg and epithelial cells; and while the whole genital anlage of the females goes to form the ovarium, only a portion of the same is used in the male to build the testes. According to the investigations of Herr Heymons the origin of the sexual glands is alike in the male to that of the female already described: the two lateral cell-bands are formed, each of which is held in place by an "endfaden-platte." Both genital and epithelial cells are present. A large number of the latter lie on the ventral side of the organ, and give rise to the vas deferens. At a particular stage of the development the genital cells of the male group themselves at four points. These are first rudiments of the four follicles which compose each testis. Each genital anlange now contains two portions: (1) the four follicles, and (2) the genital and epithelial cells, which did not enter into the composition of the first, but which can be clearly seen between them. The follicles are connected with the vas deferens, which becomes shorter, and thus draws them out of the mass. The above-mentioned cells which were between the follicles are held in position by the "endfadenplatte," and represent, as Herr Heymons has most conclusively shown, *the rudiment of a female genital gland.* The further development of this organ is very variable in different individuals; details may be found in the paper itself. Of special interest is the fact that Herr Heymons found some cases in which the males possessed typical ovarian tubes with eggs and follicle, and that these were developed near the testes follicles. According to this the anlage of the male genital glands in the Phyllodromia must be regarded as hermaphroditic.

As the roaches are among the simplest and earliest insects, Herr Heymons draws the conclusion that the latter are probably descended from hermaphroditic forms.

Further particulars on the above-reviewed "preliminary," and of Herr Heymons's other investigations in this line, will be looked for with considerable interest.—C. W. STILES, *Leipzig, October, 1890.*

Studies on the Wrist and Ankle.—Dr. C. Emery[1] starts with Gegenbaur's morphological principle that the centrale must have had a primitively central position, and that where several centralia are present they form a connected group; but he rejects the views of Howes and Ridewood[2] that there may be a translocation of centralia to the radial and ulnar sides of the hand. He further accepts the views of Götle and Leboucq regarding the rays of the carpal and tarsal members. First he shows that in the hand of the larva of *Rana esculenta* traces of an intermedium are visible, and that the so-called centrale is a true centrale. Next he attacks the problem of the true nature of the so-called naviculare in the Anura. Comparing the carpus and tarsus of a frog, the similarity of the navicularia in both is apparent, but the naviculare tarsi is apparently, as Wiedersheim has pointed out, the tarsale of the prehallux; hence, says Emery, the so-called thumb of the frog must be a prepollex, or otherwise the prehallux must be hallux, and then the last fibular toe would be post minimus. He holds the former view. A larva of Pelobates with six toes is regarded as settling this point.

From this he turns to the existence of the prepollex in the Mammalia, and to Bardeleben's recent paper[3] on the foot of Pedetes. Similar bones to those described by Bardeleben as elements of the prepollex are known in other mammals, especially in the Rodentia. In other cases these structures are apparently ossifications of tendons. In the embryo of a rabbit Emery finds a true prepollex developed entirely independently of the fascia palmaris. This later migrates to the volar surface of the manus. This prepollex shows as many similarities with that of the Anura that Emery is not in doubt of their homology. Emery, however, regards the nail described by Bardeleben[4] on the prepollex of Pedetes as merely a horny growth. Bardeleben in turn[5] reaffirms his original statement, and quotes from a letter by Kohlbrugge, in which three specimens are mentioned with a true nail on this digit and a fourth with a horny cup. He also supports Bardeleben in his view of two phalanges in the prepollex of Pedetes.

[1] *Anat. Anz.*, V., 283.

[2] Proc. Zool. Socy. London, 1888.

[3] Proc. Zool. Socy. London, 1889.

[4] *l. c.*

[5] *Anat. Anz.*, V., p. 321, 1890.

Skull of Sharks.—P. J. White has an account of the skull and visceral skeleton of the Greenland shark (*Læmargus microcephalus*) in the *Anatomischer Anzeiger*, V., No. 9. The cartilage is soft, and, except in the visceral arches, is without calcareous deposits. Among the peculiarities are the following: The neural arch of the first vertebra freely enters the foramen magnum; a canal (hypophysis canal?) runs through the cranial floor, opening near the foot of the pituitary fossa; a median cartilage intervenes between the extremities of the mandibular rami; there are other cartilages which may represent hypohyal elements; the first basibranchial is present,—it had only been known in Cestracion of the Elasmobranchs.

Dr. Leonard Stejneger on Bufo lentiginosus woodhousei.—In *Animal Life*, No. 3, p. 116, 1890, Dr. Stejneger, who is in charge of the department of reptiles in the Smithsonian Institution, writes as follows: "Prof. Cope, in his elaborate work on the 'Batrachia of North America,' as a reason for leaving Hallowell's *B. dorsalis* out of the synonymy, makes the following statement: 'There is nothing in the description nor the figure to enable us to ascertain what species or subspecies is represented. The evidence is as much in favor of the specimen having been a *B. l. americanus* as a *B. l. woodhousei*, and no locality is given to assist in reaching a conclusion.' This not so, for in the first place Hallowell gives the locality of the only specimen expressly as 'San Francisco Mountain, New Mexico' (*i.e.*, Arizona), and the second place mention is made of the shortness of the head ('Length of head, 8 lines; length of head and body, 3 inches,' consequently 'head 4.5 times in length'). Moreover, Girard, who afterwards examined and partly described the type specimen, simply changed the name because *B. dorsalis* was already preoccupied by Spix, and we are well warranted in regarding the only specimen brought home by Dr. Woodhouse as the type of *B. woodhousei*. Finally, the type of *B. dorsalis*, so far from not being found, is one of the very specimens enumerated by Prof. Cope, viz., No. 2531. The 'Calif Mountains' in the original entry on the museum record book is simply a slip for San Francisco Mountain, and is evidenced by the original parchment label still attached to the specimen, which reads: '*Bufo dorsalis*, Hallowell, San Francisco Mountain, New Mexico; S. W. Woodhouse, M.D.' This also disposes of another statement by the same author, that Möllhausen's specimen from the Canadian River (U. S. Nat. Mus., No. 2632) is the type. Girard at the time of publishing the name *B. woodhousei* had only the 'Sonoran' specimens from

the U. S. Boundary Survey and Hallowell's type of *B. dorsalis;* those from the Pacific R. R. Survey under Whipple came in later."

These statements imply a good deal of error somewhere, and it now devolves upon me show where it lies. In the first place, my statements as to the absence of anything "in the description or figure to enable us to ascertain what species or subspecies is represented" are strictly correct. As the character of the *B. l. woodhousei* is to have the head 4.5 to 5 times in the length, and of *B. l. americanus* is to have the head 4 to 4.5 times in the length, the statement by Hallowell that the head enters the length 4.5 times in the length does not help us in the least. And this is the only character cited by Dr. Stejneger. Nor does the locality help us, since *B. l. americanus* has been taken, according to Yanow, in Colorado, Utah, and New Mexico. These being the facts, *B. dorsalis* had to be relegated to the ignota until the type specimens could be found, and all names based on it had to lie in abeyance. The next specimen to which the name *B. woodhousei* was applied was that obtained by Möllhausen, and I therefore necessarily regarded that as the type. Had I followed a common precedent I would have sunk the name altogether, and used that of *B. frontosus* Cope, which applies to it.

However, Dr. Stejneger has now found the type in a specimen labeled as coming from the "California Mountains," a locality which I attempted in vain to discover when making out the list of specimens. It seems that this name is a "slip" for San Francisco Mountains. Dr. Stejneger discovers this by deciphering a parchment label which has soaked for some forty years in alcohol. This speaks well for the doctor's sight, for Hallowell's writing when fresh was generally nearly illegible!—E. D. Cope.

Notes on the Clawed Frog, Xenopus.—J. M. Leslie[6] has studied the habits of this South African frog. It lives on aquatic forms which it forces, into its mouth with its hands. It is apparently unable to eat out of water. Oviposition takes place in early spring (August), and the ova are deposited singly, and are attached to leaves or stones. The eggs at first measure one-sixteenth of an inch in diameter; twenty-four hours later, after swelling of the mucilaginous envelope, they measure one-eighth of an inch. The fish-like larvæ acquire no external gills, nor are there any horny plates or teeth in the mouth. Material has been forwarded to Dr. Schlaninsland, who wishes to study the development.

[6] Proc. Zool. Socy. London, 1890, p. 69.

Anatomy of Heloderma.—Dr. R. W. Shufeldt has a monograph [7] of the anatomy of this poisonous lizard, illustrated by three plates. Muscles and skeleton occupy most of the paper. No abstract is possible. Dr. Shufeldt does not decide as to the relationship of Heloderma, except in a negative way. He believes it but remotely related to the Varanidæ and Iguanidæ; so too with Lanthanotus and Crotaphytus. On the other hand, he believes that a study of Xantusia, Xenosaurus, and Lepidophyma will throw much light on these points. He does not appear to notice the fact that the question was settled by Cope, so long ago as 1866, so far as the osteology is concerned.

Birds.—Beddard concludes [8] that Psophia is nearest in osteological characters to the Cariamidæ, with resemblance to Œdicnemus, Grus, and Rhinochetus, and on the whole that it comes nearest the cranes. Grus seems to be the central from which radiate the Limicolæ, Rhinochetus, and the Ardeidæ, and the Rallidæ, Œdicnemus, Psophia, Cariama, and Gypogeranus.

The Name of the Kangaroo.—At a recent meeting of the Linnean Society of New South Wales [9] some discussion took place as to the meaning of the now universally accepted term kangaroo. It appears that it has been reported that in the language of the natives of the Endeavour River region the word kangaroo means "I don't know." This answer was given to Captain Cook in reply to some question, and he instead of appreciating its meaning, understood it to be the name of the animal to which it is universally applied.

Possible Occurrence of the Wolverine in Ohio.—While botanizing in Sugar Grove, Fairfield Co., Ohio, a citizen of the town told me that about Oct. 1, 1890, he had seen an animal descending a tree head downward. He described the animal as follows: "About the size of a large domestic cat, with rather long and very bushy tail, of dark color, striped on back like a chipmunk." I should judge from the description that the animal must have been a wolverine (*Gulo luscus* L). I know of no case on record of its occurrence in Ohio since 1842. Has any one seen it since that date? or is there some other animal that would answer the description?—E. V. Wilcox, *Columbus, Ohio.*

[7] Proc. Zool. Socy. London, 1890, p. 148.

[8] Proc, Zool. Socy. London, 1890, p. 329.

[9] *Zool. Anz.*, XIII., p. 564.

PHYSIOLOGY.[1]

Mr. Victor Horsley, F. R. S., who has done so much to advance the knowledge of cerebral localization, has been elected Fullerian Professor of Physiology at the Royal Institution of Great Britain, London.

Among the subjects of memoirs for which the Boston Society of Natural History offers prizes is "Original Investigation on the Physiology of Flight." The first prize is $60 to $100, and the second $50. The memoir must be in English, and must be presented before April 1, 1891. For particulars address the secretary, J. Walter Fewkes.

Time-Relations of Mental Phenomena.—In the sixty pages of his book,[2] Professor Jastrow has made a most excellent, valuable, and apparently careful résumé of the work done in this field. Simple reaction times are first discussed and analyzed, together with the effects of various conditions influencing them, such as the nature of the impression, the intensity of the stimulus, the mode of reaction, the subject's foreknowledge of what is to take place, distraction, practice, fatigue, and also the differences between motor and sensory reactions, individual variations, the action of drugs, and reaction times in the insane. Methods of experimentation are touched upon, and a table of simple reaction times, as determined by the leading investigators, accompanies. Complex or adaptive reactions, involving distinction and choice, are similarly treated, and an excellent and full table of complex reaction times is given. Several pages are devoted to a discussion of association times. There is added a fairly complete bibliography, made more valuable by its classification in accordance with the text.

Foster's Text-Book of Physiology.—The third part of the fifth edition of this work, just published by Macmillan, is a book of nearly three hundred pages, and is devoted to the central nervous system. The treatment of the subject has been entirely changed, much histological and other matter has been added, including excellent new figures, and the whole, nearly five times larger than its former size, may be considered practically a new work. It is doubtless entirely safe to say that it forms the best general treatment of the subject existing in English, if not in any language. It is a great advantage to have the histology discussed from the standpoint of the physiologist, with the

[1] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] The Time-Relations of Mental Phenomena, by Joseph Jastrow. New York, N. D. C. Hodges, 1890.

function of the part ever in view. Noticeable throughout the book is the increased and careful attention paid to the differences in the actions of the nervous systems of different species of animals and the principle of evolution of function. This principle is rightly occupying an ever-widening field in physiology, and that this is so is demonstrated by the fact that this, the foremost physiological text-book in the English language, gives it prominent consideration. Also noticeable throughout is the constant endeavor to impress the reader with an idea of the extreme complexity of cerebral operations, and the present impossibility of separating from the whole and sharply formulating the functions of a particular organ, like the optic thalamus or the cerebellum. "The physiologist ought not to use the words, 'functions of the cerebellum.' From a physiological point of view it is, so to speak, a matter of accident, that various structures, the seats of various physiological processes, have, from morphological causes, been gathered together into the body which anatomists call the cerebellum. The task of the physiologist is to unravel the ties binding these various cerebellar structures with other parts of the central nervous system, and so with various parts of the body at large." The discussions of disputed points are full, lucid, and admirable. The parts on the special senses and on reproduction remain yet to be published.

The Brain of Laura Bridgman.—The case of the blind deaf-mute, Laura Bridgman, is known the world over. Born a normal child in Hanover, N. H., in 1829, she lost almost completely, at about two years of age, through an attack of scarlet fever, her special senses, except that of touch—more exactly, the left eye was entirely blinded by the disease, but sight remained, very slightly developed, in her right eye up to the eighth year; hearing and power of speech together disappeared with the disease; smell remained very unimportant and variable throughout life; taste persisted in a small degree; the temperature sense was poor, while touch continued very acute. At about eight years of age she entered the Perkins Institution, Boston, and her education was taken in charge by Dr. S. G. Howe, the director. The results of her training are well known. Her mental development became remarkable, considering her defective avenues for the incoming of sense impressions. At twenty years of age her regular education ceased, but she continued to reside at the institution until her death in May, 1889.

A study of the brain of such an individual would be interesting, as showing the correlation of brain structure and mental development. After her death the brain was placed in the hands of Dr. H. H. Donaldson, of Clark University, for study. The first report upon the subject has just been published.[1] The author has made an extremely careful

[1] *American Journal of Psychology*, Vol. III., 1890, p. 293.

and exhaustive detailed examination of the brain, and the report is a model for its fulness and careful attention to the exact description of his procedure.

The paper deals only with the gross anatomy of the brain. Estimations of the volume (1178 c.c.) and weight (1204 grms.) showed no especial deviations from those of other brains. The cerebrum was markedly brachycephalic. A general outlook over the whole encephalon showed no striking anomalies, but a careful study of the surface of the cerebral hemispheres combined with measurements of the cortical areas revealed some interesting facts. That portion of the left inferior frontal convolution, that is generally believed to contain the centre for articulate speech, was found poorly developed, and on both sides the Island of Reil was exposed more than normally, that of the left side nearly three times that of the right The occipital lobes were somewhat flattened. The *cuneus*, which is supposed to contain the centre for vision, was normal on the left side, but imperfectly developed on the right, a fact that is to be correlated with the blindness of the left eye, and the partial sensitiveness of the right eye to light for the first seven years of Laura's life. The temporal lobes were disproportionately small, but alike on both sides. No decided evidence of defective development of the centres for hearing, smell or taste, or of exaggerated development of the centre for touch, could, however, be deduced from the gross anatomy. Measurements of the cortical areas demonstrated a better superficial development of the right Island of Reil, than the left, of the right frontal lobe than the left (due largely doubtless to the defective left inferior frontal gyrus), of the left occipital lobe than the right, and of the left "residual portion" than the right. The superficial area of the whole left hemisphere was greater than that of the right, which the author associates with the fuller development of the caudal portions of the hemisphere. Compared with the measurements of H. Wagner, Jensen and Calori, Laura's brain possessed a total area small for its weight, a fairly average length and depth of its sulci, and a slightly less than average development of the area of the frontal lobes. Reports on the thickness of the cortex and on the internal anatomy and histology are not yet published.

Course of Sensory Fibres.—The course of the sensory nerve fibres through the spinal cord and brain is not so fully understood as that of the motor fibres. His believes that the real nucleus of most sensory fibres is in the ganglion of the posterior root, not in the cord. The work of Schiefferdecker, Krause, Schwalbe, Lissauer, Bechterew, Kahler, and Takacz, has shown that upon entering the cord the posterior root fibres go in two directions, namely, a portion direct into

the posterior white columns, and a portion into the grey matter of the posterior horn. Of the former, Singer's view is supported by others, and seems correct, viz.: That these fibres form long paths direct to the medulla oblongata, where they end in the nuclei of the posterior columns. From here continuing fibres go to the cerebellum and elsewhere; but the work of Edinger, Flechsig, and Meynert has proved that a great number of the continuing fibres cross to the opposite side, and as a part of the fillet go anteriorly, and end in the corpora quadrigemina. The latter portion of the posterior root fibres mentioned above, those entering the posterior cornu, disappear in its grey matter, but the connections of this are difficult to follow. Beyond the fact that fibres may be traced laterally from Clarke's column through the lateral white columns to the direct cerebellar tract, and thence anteriorly, much confusion exists as to the fate of the other posterior cornu fibres.

Edinger[1] has employed embryological combined with comparative anatomical methods, beginning with *Anguis fragilis*, and confirming his results on other reptiles, fishes, amphibians, and mammals. From the nucleus of each sensory cranial nerve (V., IX., X.) he traces a bundle of fibres across in the medulla and anteriorly as a part of the fillet to the corpora quadrigemina. The striæ acusticæ, from the nucleus of the eighth, take the same course (Monakow). Edinger calls this connection the "central sensory path" of the cranial nerves, and searches for an analogous tract in connection with the spinal nerves. In various forms he finds this in bundles of fibres emerging from the grey matter of the posterior cornu, crossing in the anterior commissure to the antero-lateral white columns, thence ascending, joining the fillet, and ending in the mid-brain. The existence of such a "central sensory path" of the spinal nerves is confirmed by physiological experiment, by embryology, *e.g.*, His, and by pathological anatomy, *e.g.*, Auerbach and Rossolymo have found this path degenerated after destruction of the posterior horns. Hence we seem to be in a fair way to understand the central connections of the posterior root fibres. Leaving out of account those going to the cerebellum, and some few others not well understood, there are two groups. In one the fibres enter the posterior columns, ascend, pass through the ganglia of those columns, cross, and as a part of the fillet go to the corpora quadrigemina. In the other the fibres join the grey matter of the posterior cornu, cross in the anterior commissure, ascend in the antero-lateral white columns, and as another part of the fillet go also to the corpora quadrigemina.

[1] *Deutsche Med. Wochenschrift*, May, 1890, No. 20, p. 421.

ENTOMOLOGY.[1]

Meeting of Economic Entomologists.—A large majority of the official economic entomologists of North America met at Champaign, Illinois, November 11th to 14th, in connection with the meetings of the Association of American Agricultural Colleges and Experiment Stations and the Association of Official Economic Entomologists. There were present Messrs. Riley and Howard, of Washington, D. C.; Forbes, Marten, Hart, and Goding, of Illinois; Atkinson, of Alabama; Gillette and Osborn, of Iowa; Bruner, of Nebraska; Beckwith, of Delaware; Harvey, of Maine; Cook, of Michigan; Woodworth, of Arkansas; Garman, of Kentucky; Fletcher, of Canada; Alwood, of Virginia; Smith, of New Jersey; Aldrich, of South Dakota; Webster, of Indiana; Snow, of Kansas; and Weed, of Ohio. The utmost harmony prevailed throughout the meeting, which was probably the most notable and profitable one ever held by the economic entomologists of the country.

Inasmuch as the Association of Colleges and Stations has been reorganized on the section plan since the Association of Economic Entomologists was formed, so that most of the members of the latter belong to a section of the former, it was decided to hold the next meeting of the latter just before the meeting of the A. A. A. S. in August, 1891. The following papers were read, Nos. 2 to 11 being presented before the Committee on Entomology of the general Association.

1. Report of Committee on Entomology, by S. A. FORBES. Read before the Association of Agricultural Colleges and Experiment Stations. This consisted of a masterly review of the work in entomology carried on at the stations during the year.

2. Notes on Insecticides, by M. M. BECKWITH, detailing experiences in fighting the rose chafer, spraying for the codling moth, etc.

3. A New Root Rot of Cotton, by G. F. ATKINSON, showing that cotton roots are attacked by Nematodes, and serious injury is sometimes done.

4. Experiments and Observations in Iowa, by C. P. GILLETTE, reviewing the more important results obtained at the Iowa Station this year.

5. Methods of Laboratory Experiment, by C. W. WOODWORTH. A general discussion of methods of testing the effects of arsenites upon plant foliage, and ways of tabulating results.

[1] Edited by Dr. C. M. Weed, Experiment Station, Columbus, O.

6. New Notes on the Hessian Fly, by JOHN MARTEN, showing that there may be a fourth brood at times.

7. Life-History of *Baris confinis*, by C. M. WEED, showing that this insect develops in Spanish needles (Bidens sp.)

8. Life-History of Certain Aphididæ, by C. M. WEED, showing the autumn and winter history of a number of little-known species.

9. Life-History of *Pimpla inquisitor*, by C. M. WEED, detailing observations on the egg and larval history of this insect.

10. Contagious Diseases of Chinch Bug, by F. H. SNOW, reporting a number of successful experiments in spreading contagious disease among chinch bugs.

11. Host Relations of Hymenopterous Parasites, by L. O. HOWARD, showing the need of more precise knowledge of breeding habits of parasites, and the value of knowing the biological laws governing them.

The following papers were read before the Association of Official Economic Entomologists:

12. Address of the President, by C. V. RILEY, reviewing recent entomological work of the Department of Agriculture, and many other points of general interest.

13. Our Work and Bulletins, by A. J. COOK. A general discussion of the scope of entomological work at the stations, and methods of publication.

14. Fertilizers as Insecticides, by J. B. SMITH, showing the value of potash salts as insect destroyers.

15. The Habits of Pachyneuron, by L. O. HOWARD.

16. Notes on the Plum Curculio, by J. B. SMITH, reporting a number of observations upon this insect.

17. Notes on a New Apple Pest, by F. W. GODING.

18. Notes on the Genus Phylloxera, by C. V. RILEY.

19. An Experience with the Rose Bug, by J. B. SMITH, showing the inefficiency of nearly all ordinary insecticides.

20. Some Questions Relating to Aphides, by J. B. SMITH, discussing the poriferous structure of the antennæ, and its significance.

21. Notes on the Plum Curculio and Gouger, by C. P. GILLETTE, reporting observations on life-history, and experiments with remedies.

22. Original Work at the Stations, by C. V. RILEY. A general discussion of the subject.

23. Notes on Beet-Root Insects, by L. BRUNER, detailing observations made in Nebraska.

24. Invasion by the Clover-Leaf Beetle, by J. B. SMITH.

25. London Purple on Peach, by A. J. Cook, reviewing spraying experiments in Michigan and at Cornell University.

26. Life-History of White Grubs, by S. A. Forbes, showing that all our common species pupate in the fall, and describing early stages of several species.

27. Life-History of the Corn-Plant Louse, by S. A. Forbes, reporting investigations during a number of years by which many new points in the life-history of this insect have been brought out.

In addition to these numerous papers, the discussions throughout were of unusual interest. The entomologists are certainly to be congratulated on the large attendance and number of papers, as well as the evident desire manifested throughout the sessions to help each other in forwarding the work in which they are engaged.—Clarence M. Weed.

The Screw Worm.—Two bulletins concerning this insect (*Compsomyia macellaria*) have lately been issued. The first is by Dr. M. Francis, of the Texas Experiment Station, and the second by Prof. H. A. Morgan, of the Louisiana Station. That by Dr. Francis is quite short, but gives illustrations of all the stages of the insect, engraved from drawings by Miss Freda Detmers, which are shown at Plate XXXV. Dr. Francis quotes from a letter in which Dr. S. W. Williston states that the fly "occurs everywhere from Canada to Patagonia," but adds that only in Texas is it of economic importance in the United States. Cattle are especially liable to attack, but horses, mules, hogs, sheep, dogs, and in some recorded cases even men, are attacked. Dr. Francis continues:

"In all animals alike, the eggs, after being laid by the fly, hatch into larvæ or so-called 'worms.' The exact length of time this requires seems to vary with circumstances. My present opinion is that, if the eggs are laid in a moist place and on a warm day, it requires less than one hour; whereas, if laid in a dry place they seem to dry up and lose their vitality. The young larvæ when first hatched are small and easily overlooked. If they are hatched on the surface in a drop of blood from a ruptured tick, for instance, they attempt to perforate the skin, and if hatched in wounds they at once become buried out of sight. They seem to attach themselves by their heads, and burrow their way under the skin, completely devouring the soft flesh. Occasionally a few are seen moving from one place to another, but usually they remain fixed at one point. The worms grow steadily in size, and the hole in the flesh becomes larger every day. Sometimes the worm makes tunnels, but not to any depth; they usually stay on the surface.

They evidently produce considerable irritation, for the part is always swollen and constantly bleeding. This swollen, gaping appearance of the wounds, together with the constant discharge of blood, are characteristic of the presence of worms. It seems to require about a week for the worms to become fully grown. At that time they are about five-eighths to six-eighths of an inch long. They then leave the sore and go into the ground, where they pass the pupa state, and hatch out as flies in from nine to twelve days. Of several hundred hatched out by the writer, the shortest time was nine days and the longest fourteen days, but in the majority of cases it required from nine to twelve days. While the larvæ are thus developing the flies are constantly laying fresh eggs in the wounds, so that the young worms take the place of the matured ones, and thus keep up a constant and progressive loss of tissue. If the worms are not killed they eat constantly deeper, and often kill the animal. Sometimes the abdomen is opened and the bowels escape—as is especially liable in case of heifers spayed through the abdomen. At other times a tail is eaten off, or extensive caverns are made into the muscles.

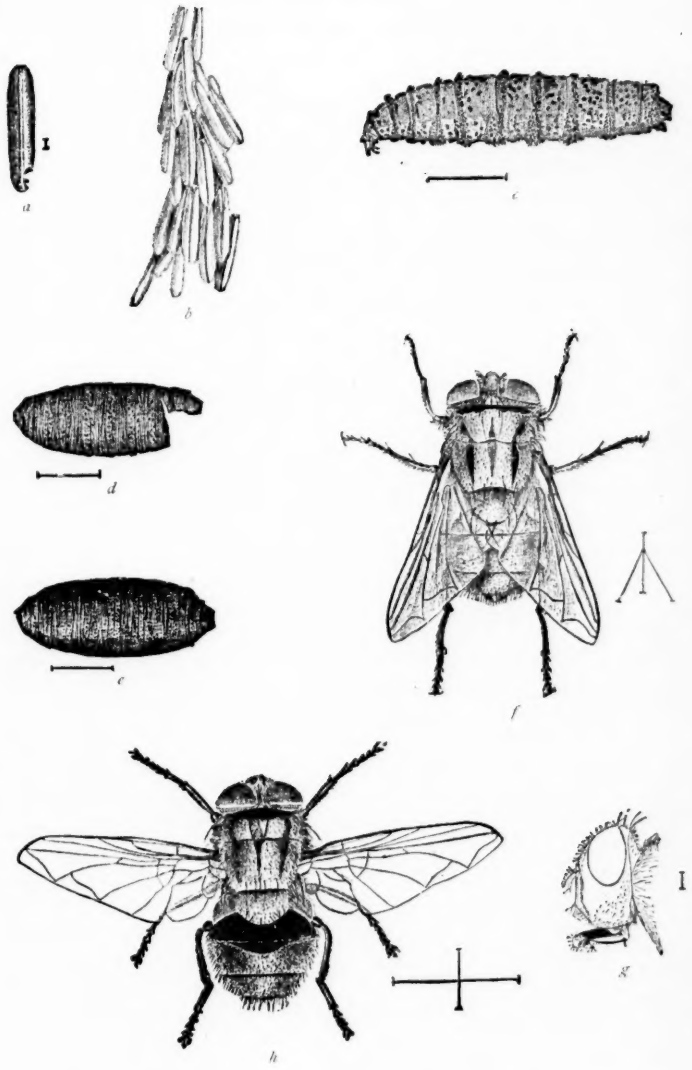
"The treatment usually employed in these cases consists simply of killing the larvæ with cresylic ointment, calomel, chloroform, or carbolic acid."

In the accompanying plate the eggs are shown at *a* and *b*, the first representing a single egg, greatly enlarged, and the second a bunch of eggs, also enlarged; the larva is represented at *c*, and the puparium at *d* and *e*, the former showing the mode of exit of the fly, which is represented at *f* and *h*, while *g* represents a side view of the head.

The egg of this insect is 1 mm. long, whitish, and cylindrical, with a longitudinal ridge on one side. The full-grown larva is 16 mm. long by 4 mm. in diameter. It is a whitish, footless grub, with transverse rows of stiff black bristles at each articulation. The puparium is brown, 10 mm. long by 3 mm. thick. The imago is described as follows: Length, 10 mm.; wing expanse, 21 mm.; color, metallic bluish-green, with golden reflections; thorax, with three black longitudinal stripes; head, except central portion of eyes, yellow; legs, black; wing veins, black; wings transparent, except near base, where they are slightly clouded. Entire body furnished with long, black, spinose hairs. Proboscis of medium length, with dilated tip.

The past summer this insect appeared in injurious numbers in parts of Louisiana and Mississippi, where it has seldom heretofore attracted attention. Prof. Morgan thinks it was imported the previous season with Texas cattle, and on account of the mild winter was not killed by

PLATE XXXV.



THE SCREW WORM (*Compsomyia macellaria*).

the frost. He has found that it is able to develop freely in decaying animal and vegetable matter.

An article concerning the appearance and injuries of the screw worm in Mississippi has lately been published by Mr. H. E. Weed, of the Experiment Station of that State, in the *Southern Live Stock Journal* (Nov. 6, 1890).—C. M. W.

North American Phycitidæ.—After many years of study of the small moths of the family Phycitidæ, Rev. Geo. D. Hulst has prepared a monograph of unusual excellence. It has been published under the title, "The Phycitidæ of North America," in the Transactions of the American Entomological Society (Vol. XVII., pp. 93–228, Plates VI.–VIII.) The systematic list given at the end of the article includes 201 species, although the author states in the opening paragraph that "it is probable that not half of our species have as yet been described." This monograph cannot fail to be of great value to working entomologists, and ought greatly to stimulate the study of these beautiful little moths. The early stages of only twenty-six species are recorded as known. The author, following his previous custom, has proposed a number of new generic terms derived from the names of extinct Indian tribes. The generic references of nearly all the well-dnown economic species have been changed; *e.g.*, the leaf crumpler (*Phycis indigenella* of authors) is now *Mineola indigenella;* the leaf skeletonizer, which so long has been called *Pempelia hammondi,* now goes to the genus Canarsia; Professor Comstock's *Dakruma coccidivora* has become a Lætilia, and the time-honored *Ephestia interpunctella* has gone back to Guené's genus Plodia, in which it seems to have been originally placed by Hübner. But these changes are inevitable, and we can only trust that the insects mentioned have received a fairly permanent generic assignment.

New Food-Plant of Rhodobænus 13-punctatus.—Pupæ and adults of this species were found in the stems of cupweed (*Silphium perfoliatum*) July 30, 1890, in central Ohio. The beetles were freshly emerged, and were crawling up the inside of the stem, evidently preparing to escape. The pupæ were in the basal portion, where abundant evidence was visible of the work of the larvæ. The latter had bored the root and basal part of the stem. No larvæ could be found at this time, all having pupated. The two later stages of the insect are shown at Fig. 1, *a* representing the pupa, and *b* the beetle. The larva has been described by Dr. Riley in the Report of the U. S. Department of Agriculture for 1881–1882 (p. 142); and in his third

Missouri Report the same author gives an account of what is supposed to be this species under the name *Sphenophorus pulchellus*. The insect

FIG. 1.—*Rhodobænus 13-punctatus; a*, pupa; *b*, beetle. Both enlarged. Original.

is there called the Cocklebur Sphenophorus, and the larva is said to bore the stalks of the common cocklebur (*Xanthium strumarium*).—CLARENCE M. WEED.

Elm Insects.—Prof. G. H. Perkins has recently distributed a 96-page memoir, extracted from the Eleventh Report of the Vermont State Board of Agriculture, upon Insects Injurious to the American Elm. Eighteen introductory pages are devoted to a consideration of predaceous and parasitic insects, insectivorous birds and other animals, and the use of insectides. Then follows a short discussion of the usefulness of the American elm, and the reasons for treating of the insects affecting it, after which appears a systematic list of seventy-eight insects injurious to the elm. A more or less complete account is then given of each of these species, the writings and illustrations of previous authors being freely used, with full credit. Unfortunately the otherwise excellent mechanical execution of the *brochure* is seriously marred by the occurrence of numerous typographical errors. In several places also slips occur, due, apparently, to a lack of the latest information. For instance, in discussing kerosene emulsion, "Prof. Riley's recipe" is said to be "a mixture of oil and milk of any desired proportions," and no mention is made of the Riley-Hubbard soap emulsion, which is now the accepted formula everywhere. And under the head of beetles infesting elms a list of species mentioned by Glover and Harris is given, the names of many of which have since been changed, and some of which are synonyms. The genera Phyllophaga and Trichestes are not now recognized in the lists of American Coleoptera. The imported coccid (*Gossypari ulmi*) is called the imported elm leaf aphis. This is unfortunate, as the term aphis should at least be restricted to insects of the family Aphididæ. But

notwithstanding these occasional slips, Professor Perkins has done a very useful work in a line where his example may well be followed.

North American Pselaphidæ.—Messrs. E. Brendel and H. F. Wickham have lately published in the Bulletin from the Natural History Laboratories of the Iowa State University (Vol. I., pp. 216–304, and Vol. II., pp. 1–84) a Monograph of the Pselaphidæ of North America, which shows evidence of much careful work. Seven plates from stipple drawings by Dr. Brendel, the senior author, fairly well represent the species described. This monograph will be a great help in the determination of species in this difficult family of beetles.

MICROSCOPY.[1]

Direct Division of the Nucleus in the Enteric Epithelium of Rhabdonema nigrovenosum.[2]—Prof. Hoyer finds in the epithelium lining the alimentary tract of Rhabdonema good material for demonstrating the so-called "direct" division of nuclei. Hoyer admits, however, that his preparations are not conclusive evidence of such division.

Following Kultzitzky's method, Prof. Hoyer killed the Nematodes in "strong alcohol," stained in alcoholic borax-carmine 24hs., decolorized in acidified alcohol 1h. (strong alcohol + 1% HCl.), transferred to glacial acetic acid (15m.), then to a mixture in equal parts of glacial acetic acid with creosote, then to pure creosote, and finally mounted in creosote balsam.

Such treatment, we should think, would be likely to bring out "direct" division. We agree with Hoyer that the case needs further investigation.

Culture of the Larvæ of Ascidians, Worms, Echinoderms, etc.[3]—Dr. Ch. Julin has found the following method, suggested by Prof. Giard, to be very useful in rearing larvæ of various kinds. Material for the study of the formation of the colonies of compound Ascidians may be easily obtained in this way:

Collect the free larvæ in a pipette at the time of hatching, and place them in covered watch-glasses containing clean sea-water. Keep them protected from the light (half-dark). "Thus kept, they develop quite

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] H. Hoyer. *Anat. Anz.*, V., 1, Jan. 1890, p. 26.

[3] Extracted from a letter from Dr. Ch. Julin to Dr. Minot, dated Sept. 3, 1889.

normally. I have thus been able to obtain excellent material for the Ascidians, and I have made successful cultures of many kinds of Annelid larvæ."

Preservation of Siphonophora.[4]—Bedot proceeds as follows: The colony is immersed in a 15–20 per cent. aqueous solution of sulphate of copper. At the same time sea-water is poured in along with the colony, in such bulk that the copper solution is ten times as great. After fixation, which happens in a few minutes, a few drops of nitric acid are added to the solution, and the mixture is gently stirred up with a glass rod, in order to prevent the formation of any precipitate. After four or five hours the preparation is to be further hardened in Flemming's mixture:

Chromic acid (1 per cent.)	15 parts.
Osmic acid (2 per cent.)	4 parts.
Glacial acetic acid	1 part.

This fluid should be allowed to act twenty-four hours, and should be twice the volume of the copper solution. A few drops of 25 per cent. alcohol are next added to the fluid, and the quantity and strength of the alcohol gradually increased, until in fifteen days 70 per cent. may be used, and finally 90 per cent.

For Tracing Nerve Fibres in the Brain.[5]—For the study of the finer structure of the fore-brain of Amphibia, Oyarzun recommends Golgi's silver method, as improved by Ramon y Cajal (*Anat. Anz.*, V., 3, 1890, p. 85). The brain is treated first twenty-four hours in the following mixture (kept dark):

Bichromate of potash (3 per cent. aqueous solution)	20 parts.
Osmic acid (1 per cent.)	5 parts.

After washing some seconds, the preparation is placed in silver nitrate solution, which should be renewed once; it is then exposed to the light. The silver solution consists of

Argentum nitric cryst.	75 gr.
Aq. dist.	100 c.cm.

This solution is followed after twenty-four hours by alcohol, to complete the hardening.

[4] *Arch. Sci. Phys. et Nat.*, XXI., 1889, p. 556; *Jour. Roy. Mic. Soc.*, Dec. 1889, p. 832.

[5] Oyarzun. *Arch. f. Mik. Anat.* XXXV., 3. 1890, p. 380.

New Methods of Staining Nerves with Methylblue.[6]—Prof. Dogiel says that nerves may be stained with methylblue, not only in muscles, but also in other organs, and in a simpler way than that of Ehrlich. It is sufficient simply to inject the vessels of the organ with a 4 per cent. solution of methylblue in the physiological salt solution. The injection is performed immediately after the death of the animal. Usually the organ is left *in situ* until the stain takes effect; but, if sufficiently thin, it can be cut out and placed in a drop of aqueous humor, and watched under the microscope until the desired effect appears. In the first case the organ must be laid bare, and its cavities, if it have any, must be opened. The stain may appear in the course of a few minutes, but often only after an hour or two. In the second case the conditions are most favorable, not only for staining, but for observing the action of the stain and noting the exact time for fixation.

A simpler method still may be employed for the demonstration of nerves in certain organs and tissues. The tissue is taken from the animal while living, or just after killing, and placed on a slide or in a watch-glass in a few drops of aqueous humor, to which are added 2–3 drops of a $\frac{1}{15}-\frac{1}{16}$ per cent. methylblue solution in the physiological salt solution. Ordinarily the stain appears in the nerves in 5–10 minutes; but the time depends much upon the thickness of the tissue. In the retina, for example, 2–3 hours or more may be required to bring out the nerves of the different layers. The nerves of cold-blooded animals stain more slowly than those of warm-blooded ones.

The fixation of the color may be accomplished conveniently by picrate of ammonium, which produces a fine, granular, violet precipitate with the methylblue, and at the same time renders the tissues quite transparent. This reagent also softens the tissue, so that it can easily be separated by the aid of needles. Twenty to thirty minutes are usually sufficient to fix the stain; but thick tissues may require from two to twelve hours.

It is important that the original blue color be made to pass into a violet without the least tinge of green; otherwise the preparation may quickly fade.

The preparation may be mounted in dilute glycerine.

A saturated alcoholic solution of picrate of ammonia will harden the tissue, so that it can be cut in pith or liver, and the sections mounted in glycerine.

[6] Dogiel. *Arch. f. Mik. Anat.*, XXXV., 3, 1890, pp. 306–312.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—November 5th.—Mr. G. H. Barton read a paper on the "Drumlins of Massachusetts"; Prof. F. W. Putnam spoke on the "Archeological Explorations in Ohio during the Past Season." November 19th.—Mr. Nathan Appleton read a paper on "Santo Domingo." December 3d.—Dr. J. Walter Fewkes spoke of "The Summer Ceremonials of the Zuñi Indians: a Study of Aboriginal Religion."—J. WALTER FEWKES, *Secretary.*

Biological Society of Washington.—November 1st, 1890.—Mr. F. V. Coville spoke of the fruiting of Ginkgo at Washington. This tree has only rarely fruited in America, due to the fact that it is dicœcious, and the staminate tree only is planted. A large specimen was referred to as growing on Analostan Island, near Washington. This tree is probably as old as any in this country, and is about three feet in diameter. The fruit described by Mr. Coville resembles a plum in general appearance, having a soft pulp surrounding a hard nutlet. The morphology of the fruit was explained, it being really a naked seed, the outer part soft and pulpy, the inner hard and nut-like. The fruit represents a single female flower with a single bract. The seed contains a large amount of albumen surrounding the embryo, which is dicotyledonous, and not polycotyledonous as in most conifers. The embryo grows after the seed is mature, and often even after it has fallen to the ground. In Japan the nutlet is eaten like the piñons of the western part of our country. The pulp has the disagreeable odor of sour paste.

In speaking of the mode of growth of the Ginkgo, Dr. C. V. Riley referred to the difference in appearance between trees in the agricultural grounds and others he had seen in Europe. The former were pyramidal, but the latter branched more widely and looked like oaks. He also said the species was, so far as he knew, entirely free from insect pests, and on this account was valuable as a shade tree.

Mr. Coville also spoke of its value as a shade tree, as it would grow in the sooty atmosphere of towns, and it was not affected by any fungus diseases.

Dr. George Marx spoke at some length on the poison glands of the genus of spiders Latrodectus. His investigations were undertaken in consequence of the accounts received of the serious effects of the

bite, a man having died in twelve hours after being bitten by one. That the poison was useful to the spider in killing its prey was unquestioned, but that it was powerful enough to cause the death of a man was considered doubtful. The mandibles are hollow, and from apertures near the end the poison is ejected. This poison is contained in a poison sac lying above. It varies in shape in different species, and is squeezed out by muscular contraction. The gland in the genus under consideration is very small, averaging 2 mm. long and 2 mm. wide, with a capacity of .07 cubic mm. The poison is clear, viscid, and has an acid reaction. It frequently becomes turbid. It will not mix with water, but remains in the form of granules.

Latrodectus lives under stones, and spins no web. Unlike most spiders, it drinks no water, and has a great dislike of it. If a drop be placed upon its back it goes almost into spasms, and for hours afterwards tries to brush the water off. Water destroys the poisonous qualities of the poison. In pursuing its prey in a glass jar it was seen to crawl up the sides and from its spinnerets eject several drops of a viscid fluid. The prey having been bitten, is left, and the spider returns and devours the fluid previously ejected. As to the poisonous effects of spiders' poison, it was stated that a rice bird died in seventeen seconds after having been bitten by the Mygale, or bird-catching spider. Another died in thirty seconds. Experiments to test the poison of Latrodectus were all negative, neither a rabbit, a guinea-pig, nor a mouse being affected in the slightest. The idea that spiders of this genus are capable of inflicting bites severe enough to be harmful is very widespread, but Dr. Marx regarded it as a superstition with little real foundation.

Dr. C. V. Riley stated that he believed there was some truth in the accounts of injury by spider-bites. Some cases are too well authenticated to be doubted. He referred to the different effects a bite or a sting might have upon different persons, and while one would be unaffected, another might be very seriously poisoned. He spoke of a friend who was at one time noted for his skill in handling bees, and he was never stung. But on one occasion he was stung, and so severely that he came near dying. After that he could not go near the bees without being stung and being poisoned by it.

Dr. Theobald Smith stated that the effect of poison was somewhat analogous to that produced by bacteria. It was commonly supposed that diseases were caused by the rapid and excessive multiplication of bacteria. This seems to be a mistake, and it is to a poison produced during the increase of the bacteria that the ill effects are due. Ani-

mals can be innoculated with rattlesnake poison, and can eventually be bitten and experience no bad effects.

Prof. Joseph F. James read a paper upon "Fucoids and Other Problematic Organisms." He referred to his studies of the problematic organisms. He did not consider that the absence of carbonaceous matter was any evidence in itself that the forms were not Algæ. Under the head of "Probabilities of Preservation of Algæ" he referred to the structure and place of growth of sea-weeds, and quoted Lesquereux's opinion that the plants are very rarely preserved, stating further that the strata containing the problematic organisms contain no fossil shells in anything like a perfect condition. Fragments are found in quantities, and if calcareous organisms are destroyed cellular Algæ would stand a much poorer chance. The exposed beaches would, however, be in an admirable position to retain raindrop impressions, mud cracks, and other inorganic markings, as well as worm burrows or trails made by shells or crustaceans. Under the head of "Distribution in Space and Time" he briefly outlined the localities and the formations in which various genera occur; and under the head of "Value in Correlation" spoke of Scolithus as having been largely used to characterize the Potsdam, whereas it occurs in Lower Cambrian, Calciferous, and Medina strata also. He did not regard the problematic organisms as of value *by themselves*, but taken in connection with lithology, stratigraphy, sedimentation, and the presence of undoubted organic remains, they might be of some use. He could see no objection to the naming and description of the forms if they were regarded as crustacean, or Annelid trails or borings, or as of inorganic origin; but he thought they should not be referred to the Algæ when they had no affinity to plants.

November 15th, 1890.—Dr. C. Hart Merriam gave a short account of some of his experiences during the past summer in the cañon and lava beds of the Snake River country, Idaho. The lava beds are many hundreds of miles in extent to the north of the river, but are much smaller on the south. The country is peculiar and forbidding in aspect. Two or three buttes are known in the region, one of which is a great volcanic cone over 2,000 feet high. Lava flows and ridges are frequent, some of the former having a very recent aspect, the twists and bubbles of the lava being still plainly visible. The crust of the bubbles is a foot or two thick, and as it is liable to break at any time and allow the horse or the man to tumble into the hollow below, traveling is difficult and tiresome. The lack of water renders parts of the country almost inaccessible, and the heat in summer is intense.

Many animals live in the caves formed by the lava bubbles, there being hundreds and thousands of these.

The Snake River cuts into the lava field to a depth of 800 feet. The cliffs are of black lava, very dark, and make the cañon look deeper than it really is. The cliffs are frequently perpendicular, and are without vegetation. The lava rests upon a limestone. Shoshone Falls was referred to as very grand and beautiful, the water falling in one drop 210 feet, but having a total fall of 250 feet. A few miles above is another fall 175 feet high, and many cascades and rapids render the river unnavigable. Where vegetation is possible on the lava beds it consists almost entirely of sage bush (*Artemesia tridentata*) and several species of the so-called greasewood. Many springs are found along the base of the cliffs in the cañon, the water of these being relatively warm. Some of them are very large; four or five are even twenty feet across.

Among the insects is one known as the "Idaho Devil," about two and one-half inches long, as large as one's finger, and with a large head. It is extremely ferocious. Ants are also abundant. Some of them build nests or hills five or six feet high, made entirely of sticks, all of the same size and length; other kinds make hills of stones, these being also all of the same size. The ants hibernate in cold weather. A few birds are found, the most abundant being the sage sparrow. Mountain mocking birds, magpies, ravens, eagles, burrowing owls, ground doves, rock wrens, and cañon wrens also are found. The last, though only about as long as one's finger, has a piercing cry that can be heard several miles.

Among animals, coyotes and rabbits abound; of the latter there are four or five species. In the cañons in winter antelope and black-tailed deer are found, while panthers, badgers, wood-rats, mice, porcupines, and others live in the cañon all the year. Horned toads and rattlesnakes also frequently occur.

Mr. Theodor Holm spoke of the vegetative reproduction of *Dicentra cucullaria*. This plant is peculiar from having at the base a number of round, bulb-like bodies, which have been generally described as tubers. They are not really such, but are buds, producing late in summer or early fall, from a small depression at one end, a branch with several leaves. They are in one sense equivalent to the bulbous bases which the leaves of certain species of plants have.

Dr. W. H. Dall made some remarks upon the paleontology of the northwest coast of the United States. Certain specimens of Tertiary fossils in the collections of the Wilkes Exploring Expedition were

from unknown localities, and it was desirable to ascertain, if possible, the exact horizon whence they came. Astoria was the first place visited. It was described as being peculiarly situated, a portion being built upon the bluff overhanging the Columbia River, and the other portion occupying a narrow beach along the margin of the river. The latter part was largely built upon piles, and streets and houses extended out over the water. The houses at the foot of the bluff frequently extended into its face. The top of the bluff is covered by about six feet of basalt, below which lie Tertiary strata, layers of brown sandstone, and many nodules or concretions containing fossils. The Miocene sandstone is underlaid by Eocene limestone, in a layer about one foot thick. It was from this layer that many of the fossils were collected by the Wilkes Expedition, but it is now covered by the piles and streets and houses of the town, and is inaccessible.

The Plistocene strata on the coast rise gradually toward the south until at Monterey and south it is about six hundred feet above sea-level. The Oregonian forms are those of species living at present to the north in the colder waters of the Arctic regions; while the forms at the south are those living at present in the neighboring sea. The large lake basins of the Cascade region were referred to, many of them being occupied at present by small bodies of water more or less alkaline. Those having outlets, and consequently fresh, have a large fauna, while the alkaline lakes have no animals living in them of consequence. In marl along the Klamath Lake shells are found which live to-day in the neighboring water. But among them are some not now known to occur in a living state. Among these are species of Vivipara and Unio. These genera, though very abundant in the Mississippi valley, are unknown in a living state west of the Rocky Mountains, though they occur as fossils as early as the Laramie period. It is an interesting problem to decide why some genera should become extinct while others in the same localities lived on.

Reference was made to Stockton in the Sacramento valley, where a boring revealed gas in sufficient quantity to heat and light a large house. The city has put down numerous artesian wells, and the water thus obtained is used for domestic purposes. Some of the wells are 2000 feet deep, yet in no instance was solid rock encountered. It was all detrital material, generally coarse sand or clay. In one locality a bed of cobblestones was encountered of very local extent, being only about eighty feet wide, one and a half miles long, and from three to four feet thick. This was an isolated mass in the midst of sand or gravel. In all of the borings, many hundreds in number, no bones or wood have ever been found.

SCIENTIFIC NEWS.

Preventive Inoculations Against Tuberculosis.—At the recent meeting of the International Medical Congress, in Berlin, Dr. Robert Koch made an address in which he asserted that he had discovered a method by which animals ordinarily very susceptible to contract tuberculosis from inoculations of the bacillus were made capable of resisting such inoculations. The details of his method he did not make public. Stimulated apparently by this announcement, which is calculated to attract widespread attention, Drs. Grancher and Martin, of Paris, announced in the *Bulletin Médical*, August 20, 1890, that they also had devised a method by which these results could be obtained.

In the *Medical and Surgical Reporter* Professor Samuel G. Dixon, of Philadelphia, presents a short article in which attention is called to the fact that a year ago—October 19, 1889—he had proposed the lines upon which preventive inoculations against tuberculosis might be expected to be successfully carried out, and that he had already succeeded in a certain number of instances in producing immunity against the disease in animals. The announcement antedates by so much the announcements of Koch, and Grancher and Martin, that American medical men must feel an interest in maintaining the priority which belongs to this country.

In this particular matter it may be pointed out that Dr. Dixon in his announcement gives some indications as to the method by which he obtains the attenuated virus used in his experiments. Intimations of this sort are totally lacking in the communications of Koch, Grancher and Martin.

President Charles A. Schaeffer, of the Iowa State University, was the recipient for the university of a valuable gift from a Sioux City gentleman. The gift consists of the entire scientific collection and library of D. H. Talbot. Mr. Talbot is an old resident of Sioux City, living north of the city on a farm, where he has for years carried on the study of natural history and of science. His farm is stocked with animals of all kinds, and he has made a special study of their habits. He has also made a remarkable collection of preserved specimens. These specimens and his library are conveyed to the state university for the benefit and advancement of science. The library will remain with him until his death, but the specimens will at once be taken to the state university at Iowa City.

The library consists of about 4,000 volumes, some of them rare and valuable works, and containing treatises on almost every scientific subject. It is indeed a wonderful collection of scientific works. To place an accurate valuation upon it would be impossible, but those who are in a position to have a general knowledge of the library say that $20,000 would be a conservative estimate of its value. Some of the single books are alone worth a great deal on account of their rarity. Mr. Talbot is a diligent student of science, and he has some knowledge of almost every subject treated of in the whole library.

ERRATA.

Correction of Misprints.—Owing to the circumstance that Dr. G. Baur did not receive any proofs of his notes published in this journal a great number of misprints occur which need correction.

1. "The Gigantic Land Tortoises of the Galapagos Islands," December, 1889, pp. 1039–1057.
   Page 1039, line 4 from below, read "T. N. Reynolds" for "Z. N. Rheynolds."
   Page 1044, line 2 from above, add "I am convinced that *T. vicina* Guenther is the same as *T. elephantopus* Harlan."
   Page 1044, line 3 from below, read "schaetzte" for "schaetzts"; "wurden" for "den war."
   Page 1045, line 19 from above, read "Bindloe" for "Burnloe."
   Page 1045, line 24 from above, read "island" for "land."
   Page 1047, line 8 from below, after "island" put "[Hood]."
   Page 1057, line 6 from above, read "230" for "2300."
   Page 1057, line 17 from above, read "ten millions" for "one hundred thousand."

2. "The Relationship of the Genus Dirochelys," December, 1889, pp. 1099–1100.
   Page 1099, line 16 from above, read "*dorsalis*" for "*dorsalia.*"
   Page 1099, line 2 from below, read "*orbicularis*" for "*orbicularia.*"
   Page 1100, line 5 from above, "Deirchelys Ag. (name only)" has to be placed on line 6 behind Dirochelys Ag.

3. "The Genera of the Podocnemididæ," May, 1890, pp. 482–484.
   Page 483, line 11 from below, read "cervicals" for "cervical."
   Page 484, line 1 from above, read "Sternothæridæ" for "Pelomedusidæ."

4. "Note on the Genera Hydraspis and Rhinemys," *ib.*, pp. 484–485.
   Page 484, line 10 from below, read "which he considers the type" for "which I consider the type."
   Page 485, line 5 from above, read "Phrynops" for "Rhinemys."
   Page 485, line 5 from above, after "Schweigg." insert, "The type of Rhinemys is *Emys rufipes* Spix."

5. "On the Classification of the Testudinata," June, 1890, pp. 530–536.
   Page 530, line 8 from below, read "Testudinata" for "Testudinate."
   Page 531, line 18 from above, read "Bull. Soc. Philom." for "Brit. Soc. Philos."
   Page 531, line 19 from above, read "Ordn." for "Order."
   Page 531, line 8 from below, read "1802" for "1806."
   Page 532, line 5 from above, read "Ritgen" for "Ritzen."
   Page 532, line 7 from above, read "Vergl." for "Vogl."
   Page 532, line 7 from above, read "I. Aufl." for "Aufl."
   Page 532, line 13 from above, read "place" for "plate."
   Page 532, line 13 from below, insert quotation marks after "supposed."
   Page 532, line 12 from below, take out quotation marks after "assigned."
   Page 532, line 8 from below, read remove "Bemerkungen über die systematische."
   Page 533, line 9 from below, read "nuchal" for "nuchol."
   Page 533, line 4 from below, read "bone" for "line."
   Page 534, line 2 from below, read "four" for "five."
   Page 535, line 5 from below, place "or" before "entirely."

6. "An Apparently New Species of Chelys," October, 1890, pp. 967–968,
   Page 968, line 1 from above, read "jaws without horny beak" for "jaws."
   Page 968, line 5 from above, read "shows" for "showed."
   Page 968, line 6 from above, read "palates" for "plates."
   Page 968, line 17 from above, read "hardly" for "harely."
   Page 968, line 19 from above, read "catalogue" for "catilogue."